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FERTILIZER AND ORGANIC MATTER STUDIES WITH THE VIKING RED RASPBERRY

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This fertilizer study is an expansion of a previous experiment with the Viking red raspberry carried on from 1930 to 1934 and reported previously (1). Its main purpose was to evaluate the effects of nitrogen, phosphorus, potassium and farm manure when used in conjunction with additional organic matter in the form of chopped straw. Neither farm manure nor other additional organic matter was used in the original experiment.

No attempt has been made to review the literature as this was done fairly extensively when reporting the previous investigation.

EXPERIMENTAL CONDITIONS

The present planting is located on the same area as the original experiment and the same plot arrangement was used (see Figure 1). The total area is nearly $1\frac{1}{2}$ acres.

The soil is Vineland Fine Sandy Loam, 3 feet to 7 feet 6 inches deep, resting on an impervious clay. This type of soil is low in organic matter. It was found by test to be low in replaceable potassium but the supply of phosphorus was moderately good. The nitrogen status was not determined. Values for pH were found to be 6.5 to 6.6 with a tendency to slightly higher ratings after three years of fertilizer applications.

Tile drains, at 24-foot distances, run lengthwise of the area. Water-table studies for three years indicated that the water level fluctuated considerably but at no time was it nearer to the surface than 20 inches and so drainage was considered to be satisfactory.

The earlier experiment consisted of 64 plots with eight treatments—Check (o), N, P, K, NP, NK, PK and NPK—arranged in eight randomized blocks which permitted eight replications. A plot consisted of sixteen plants set on the square, each 6 feet by 6 feet. Kinds and quantities of fertilizers used are given in Table 1. These were applied well beyond the plot area to about 18 inches from the buffer rows. The fertilized area was therefore approximately 1/60 of an acre.

Amounts of fertilizers to be used were decided arbitrarily, the main consideration being that enough should be applied to satisfy the fixation requirements of the soil and to leave a surplus for the use of the plant. An injurious excess was considered as very improbable.

There were marked increases in both potassium and phosphorus in the top soil after the three applications in 1932, 1933, and 1934 (1). In the subsoil, potassium showed a slight but consistent increase whereas phosphorus was rather variable.

TABLE 1.—PER ACRE RATES OF FERTILIZER APPLICATIONS FOR THE YEARS 1932, 1933, AND 1934

Fertilizer used	1932[1]	1933[1]	1934[2]
	lb.	lb.	lb.
Nitrate of soda (16%)	300	600	600
Superphosphate (20%)	750	1200	1200
Sulphate of potash (30%)	480	480	480

[1] Fertilizers worked into ground with spring-tooth cultivator several days after sowing.
[2] Superphosphate and potash plowed under immediately after application. Nitrate worked in by cultivation.

SUMMARY OF RESULTS OF EARLIER EXPERIMENT (1)

1. Seasonal differences in growth and yield were quite marked.

2. Nitrate of soda, 300 lb. per acre, increased yields in a cool moist season (1932) but 600 lb. per acre decreased yields in dry seasons (1933 and 1934).

3. Superphosphate gave no significant results.

4. Sulphate of potash gave significant yield increases in 1933 and 1934.

5. Apparently there was no interaction between fertilizers in combination.

The experiment was discontinued after the 1934 crop, chiefly on account of the prevalence of virus disease (mosaic). Plants were dug out in the fall of 1935 and an application of about 15 tons of farm manure per acre was applied. The land was then ploughed and sown to rye which was turned under in spring 1936. This was followed by alfalfa which gave a poor stand and so was ploughed down in the fall of 1937. Two crops of corn were ploughed under in 1938, and the ground was subsoiled in the fall of that year.

During 1935, 1936, 1937 and 1938, fertilizers were applied to the vacant plots in quantities shown in Table 2, and for the period 1932 to 1938 the totals are given in Table 3.

TABLE 2.—PER ACRE RATES OF FERTILIZER APPLICATIONS FOR THE YEARS 1935 TO 1938, INCLUSIVE

——	1935	1936	1937	1938
	lb.	lb.	lb.	lb.
Nitrate of soda	200	200	200	240
Superphosphate	480	480	480	480
Sulphate of potash	320	320	320	360

TABLE 3.—TOTAL QUANTITIES OF FERTILIZERS PER ACRE USED FROM 1932 TO 1938

Nitrate of soda	2340 lb.
Superphosphate	5070 lb.
Sulphate of potash	2760 lb.

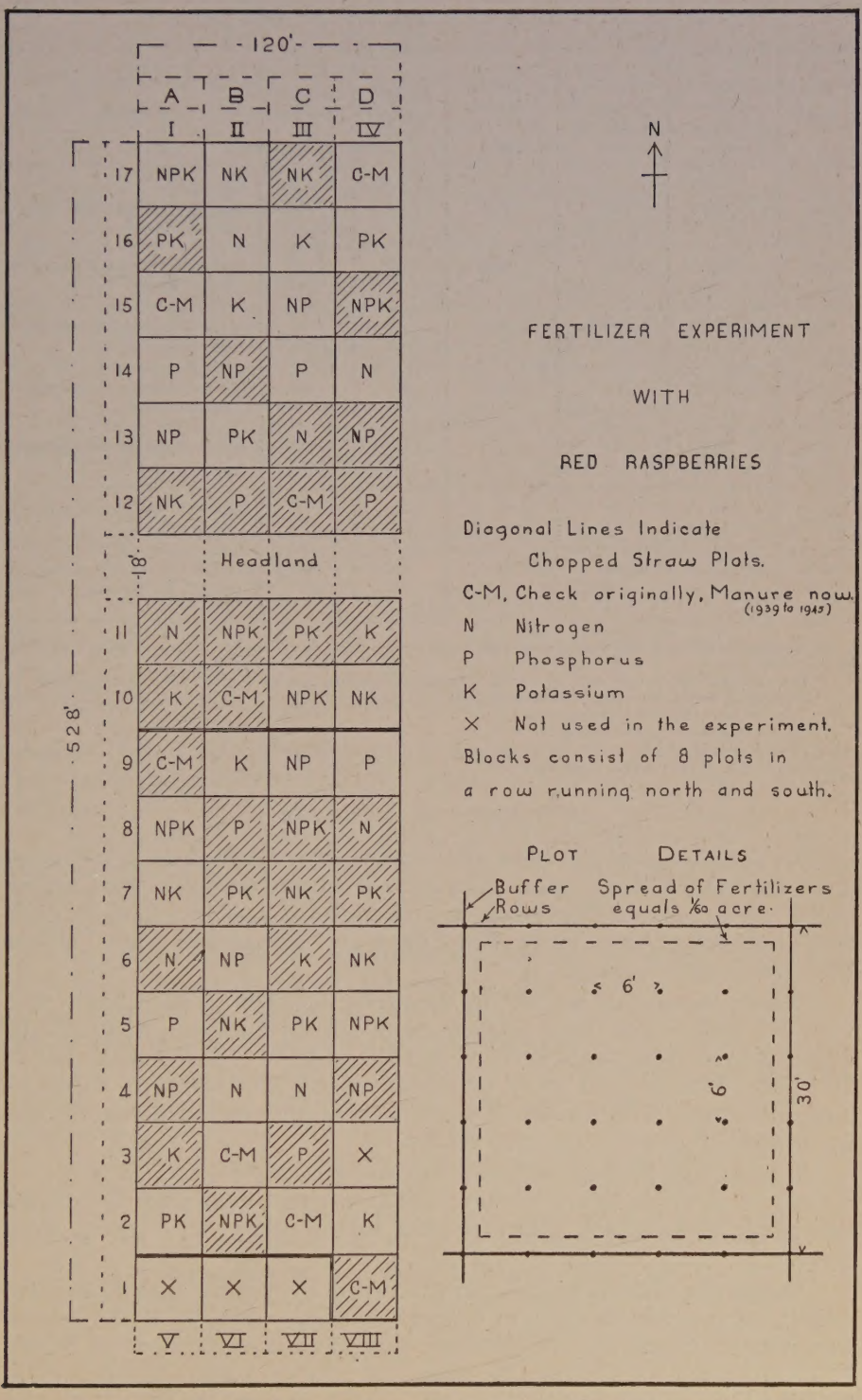


FIGURE 1. Details of plot arrangement in raspberry fertilizer experiment.

TABLE 4.—PLOT TREATMENTS FROM 1939 TO 1945, INCLUSIVE

Year	Nitrate of soda, pounds per acre	Super-phosphate, pounds per acre	Sulphate of potash, pounds per acre	Manure, tons per acre	Straw, tons per acre	Remarks
1939	240	480	360	15	2 (*a*)	Applied in *spring* and ploughed under at once
1940	240	480	360	15	2 (*a*)	Applied in *spring* and ploughed under at once
1941	240	—[1]	360	10	3 (*a*)	Applied in *spring* and ploughed under at once
1942	240	—	—[2]	10	3 (*b*)	Applied in *spring* and ploughed under at once
1943	240	—	—	10	3 (*c*)	Applied in *late fall* and ploughed under at once
1944	130[3]	—	—	10	3 (*d*)	Applied in *late fall* and ploughed under at once
1945	240	—	—	—	—	No manure or straw applied as plants were pulled out after fruiting

[1] Analyses of soil samples showed that the soil in the phosphate plots was high in phosphorus hence omitted in 1941 and later.
[2] Tests showed that potash plots were high in replaceable potassium, hence omitted in 1942 and later.
[3] Sulphate of ammonia instead of nitrate of soda.
(*a*) Plus 200 lbs. of nitrate of soda per ton.
(*b*) No extra nitrogen applied this year.
(*c*) Plus 150 lbs. of nitrate of soda per ton.
(*d*) Plus 70 lbs. of ammonium nitrate per ton.

EXPERIMENTAL METHODS

As already stated the same plot arrangement was used for this experiment as in the original study. The same fertilizers were used except that check* plots received farm manure, and one-half of all the plots in each block received chopped straw (see Figure 1). Treatments from 1939 to 1945 are given in Table 4.

Young canes were set out in the spring of 1939. The weather was very dry and so planting conditions were not favourable. Many plants died and from 1014 plants in the plots 123 had to be replaced in the fall of 1939; also 56 more had to be replaced in 1940. By reason of so many replacements yield figures for 1940 were considered unreliable and so are not included in the experimental results.

Each spring, immediately prior to pruning, observations were made on the degree of winter injury to canes and an attempt was made to evaluate this injury in each plot. Ratings from 10 (no injury) to 0 (dead) were given.

Quantities of fruit picked were recorded by volume rather than by weight, as this was thought to be more reliable, especially if the berries were damp; hence the change from the previous experiment in which

* These plots received no treatments in the earlier experiments and were originally designated O or C, now C-M.

TABLE 5.—FRUIT YIELDS IN PINTS

Treatments	1941		1942		1943		1944		1945		Sums of means	
	−Straw	+Straw	−Straw	+Straw	−Straw	+Straw	−Straw	+Straw	−Straw	+Straw	−Straw	+Straw
M	35.7[1]	31.7	36.1	19.7	48.5	48.9	60.9	43.1	38.4	30.9	219.6	174.3
N	22.6	14.1	21.1	8.4	35.6	34.4	29.4	34.0	27.4	37.3	136.1	128.2
P	27.3	22.9	21.2	17.7	30.8	47.0	37.0	56.0	19.5	44.7	135.8	188.3
K	25.5	31.5	24.2	21.4	38.5	60.5	41.8	63.0	20.4	50.1	150.4	226.5
NP	26.7	16.8	30.1	9.3	34.6	42.7	35.8	52.6	30.6	45.9	157.8	167.3
NK	32.2	27.3	32.9	21.3	52.4	50.8	54.9	53.0	45.7	46.8	218.1	199.2
PK	23.5	21.8	31.3	20.2	50.8	50.0	50.9	58.4	37.1	53.4	193.6	203.8
NPK	20.4	14.3	33.6	11.1	51.0	42.2	59.2	57.4	49.5	51.9	213.7	176.9
Sums of means	213.9	180.4	230.5	129.1	342.2	376.5	369.9	417.5	268.6	361.0	1425.1	1464.5

[1] Means of 2 plots.
Straw applied in *spring* 1939 to 1942, in *fall* 1943 to 1944.

weights were used. Size determinations were made each year by taking random pint boxes from each plot at picking time, and counting the fruits therein.

The number of boxes thus counted varied from year to year, *i.e.*, 1 box per plot per picking for 3 to 6 pickings in 1941; 1 box per plot per picking for 5 pickings in 1942; 1 box per plot for 2 pickings in 1943 and 1944, and 1 box per plot for 1 picking only in 1945.

In November, 1941, weed growth in each plot was rated by points, 10 (exceptionally heavy) to 1 (very sparse). No further weed ratings were made, however, on account of lack of uniformity in time and amount of cultivation after the picking season was over.

Soil samples from the treated plots were taken twice during the course of this experiment, 1939 and 1945. Some of these were analysed for phosphorus, potassium, and organic matter.

In 1943, two major changes were made in the experiment. First, the time of application for both straw and manure was changed from spring to fall. The straw plots were showing marked declines in yield and it was thought the spring applications might be harmful through drying the soil and thus reducing the water supply available to the plants. Second, in plots 12 to 17, A, B, C, D, which constitute the major part of blocks I, II, III and IV (the north end of the field) there were many very poor plants, due to some condition other than plot treatment. Variable and shallow

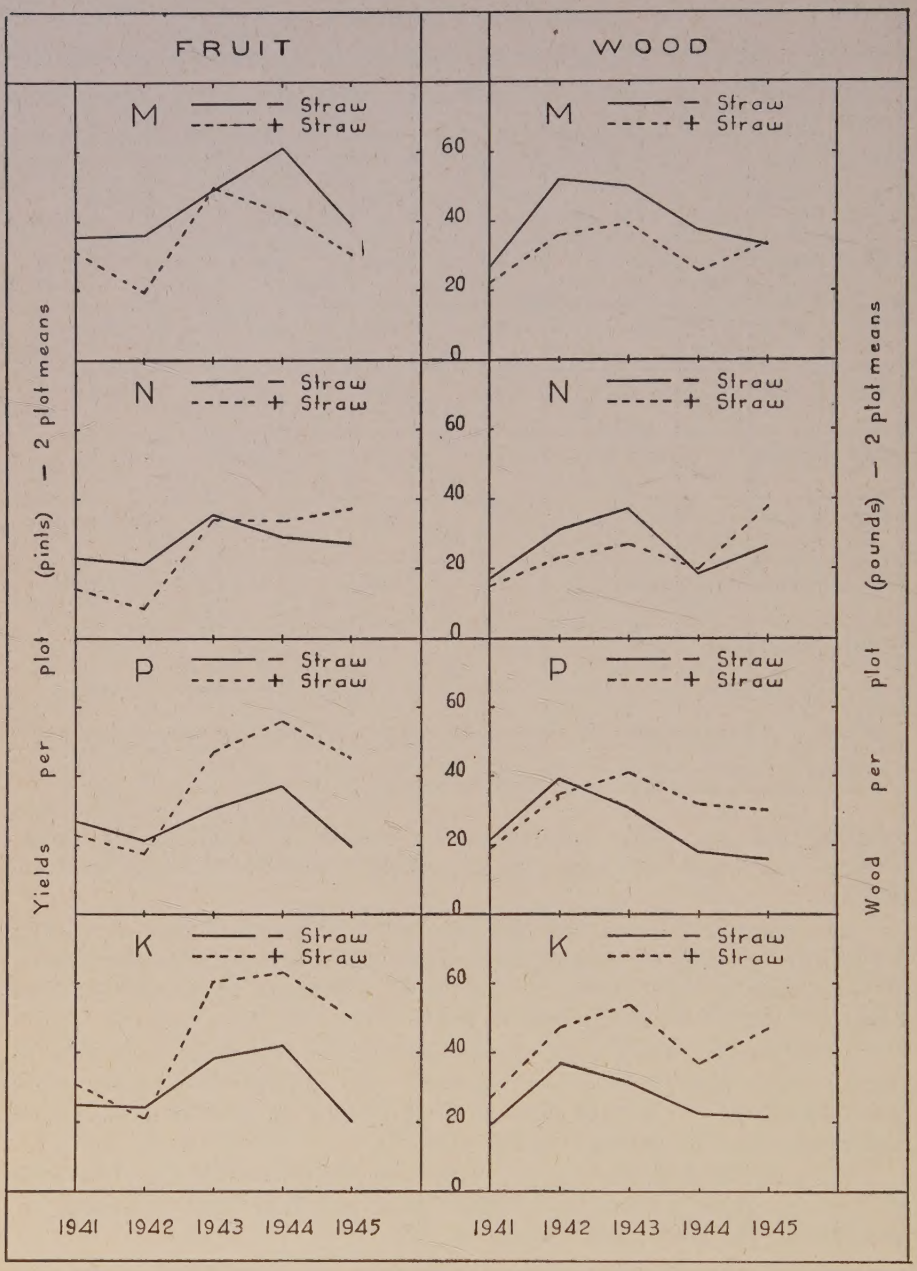
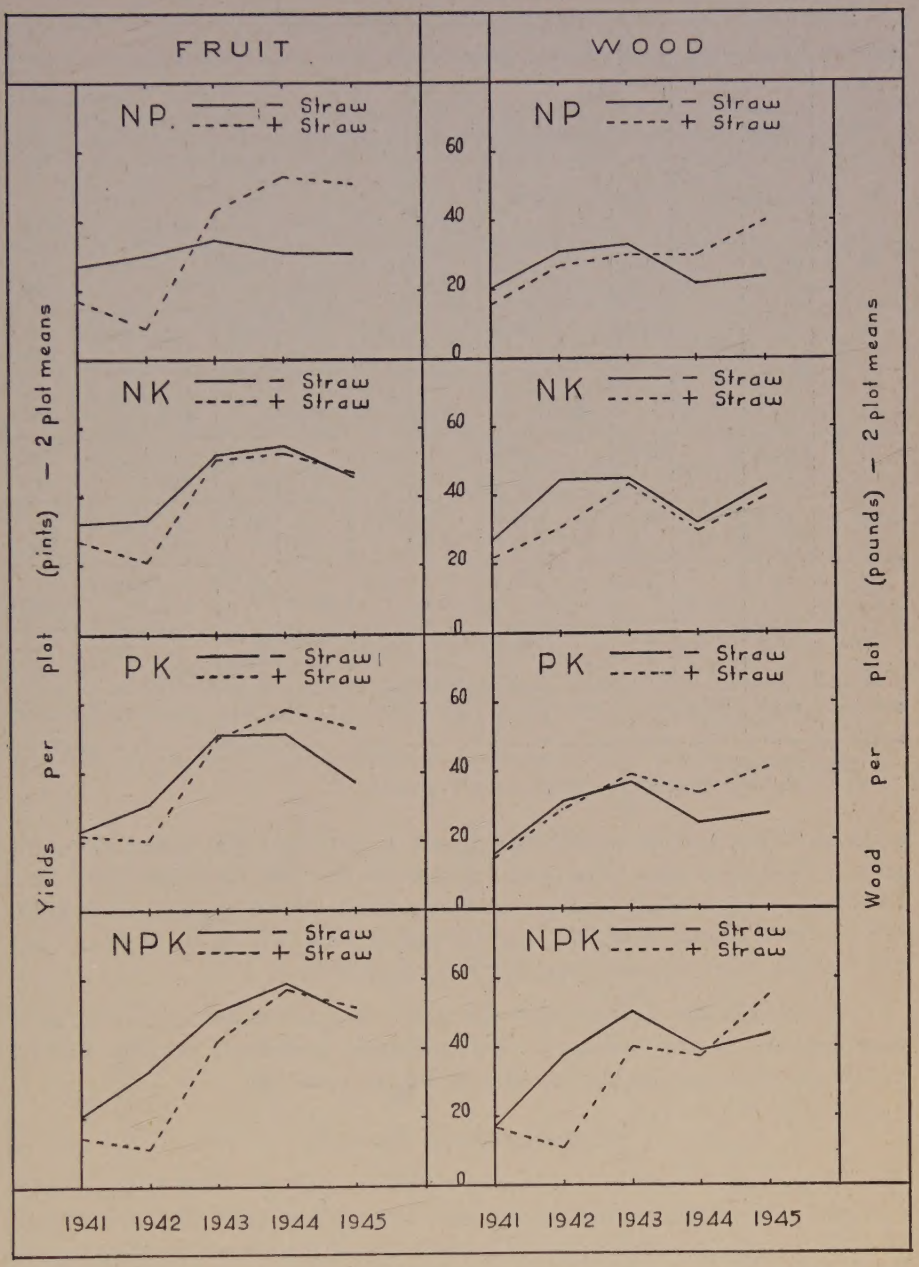


FIGURE 2. Comparison of straw and non-straw plots.



Straw was applied in spring in 1941 and 1942, and in fall 1943 and 1944.

TABLE 6.—WOOD IN POUNDS

Treatments	1941		1942		1943		1944		1945		Sums of means	
	−Straw	+Straw	−Straw	+Straw	−Straw	+Straw	−Straw	+Straw	−Straw	+Straw	−Straw	+Straw
M	26.6[1]	22.1	52.0	36.0	50.0	39.6	37.7	25.9	33.3	33.8	199.6	157.4
N	17.3	15.2	31.2	22.9	37.1	27.0	18.2	19.8	26.0	37.6	129.8	122.5
P	20.7	19.0	39.0	35.0	30.6	44.7	18.2	32.0	16.2	30.7	124.7	161.4
K	19.7	27.0	36.7	45.3	31.7	53.8	22.2	36.7	21.6	47.0	131.9	209.8
NP	20.5	15.7	31.0	26.8	33.0	30.0	21.7	29.7	23.7	39.7	129.9	141.9
NK	27.0	21.8	44.3	30.6	44.7	43.1	32.0	29.7	43.3	39.7	191.3	164.9
PK	16.1	15.1	31.3	29.3	36.9	39.2	24.7	33.7	27.7	41.4	136.7	158.7
NPK	16.8	16.9	37.8	21.1	45.2	40.3	39.2	37.5	43.8	54.8	182.8	170.6
Sums of Means	164.7	152.8	303.3	247.0	309.2	317.7	213.9	245.0	235.6	324.7	1226.7	1287.2

[1] Means of 2 plots.
Straw applied in *spring* 1939 to 1942, in *fall* 1943 and 1944.

soil and crown gall were probable causes of generally poor plant performance. Since this area was poor irrespective of plot treatment and was localized in the north block, it was finally decided to disregard, after 1943, the whole of blocks I, II, III, and IV—plots 10 to 17, A, B, C, D. Thus the number of replications was cut from four to two.

By 1945 it was evident that the plants in the whole experiment were deteriorating, mainly owing to the presence of disease, notably mosaic and crown gall, and so the experiment was terminated.

EXPERIMENTAL RESULTS

Five years' results were obtained in this experiment, from 1941 to 1945, inclusive. Fruitfulness and growth were the main criteria used to evaluate the different treatments, but weed growth, size of fruit, and degree of winter injury to canes were also considered. While commercial fertilizers were used much as in the original experiment the primary interest in the present experiment is the effects of farm manure and chopped straw.

Quantities of fruit and wood as given in Tables 5 and 6 are the means for two plots as indicated by footnotes. They are arranged so that treatments both with and without straw may be compared.

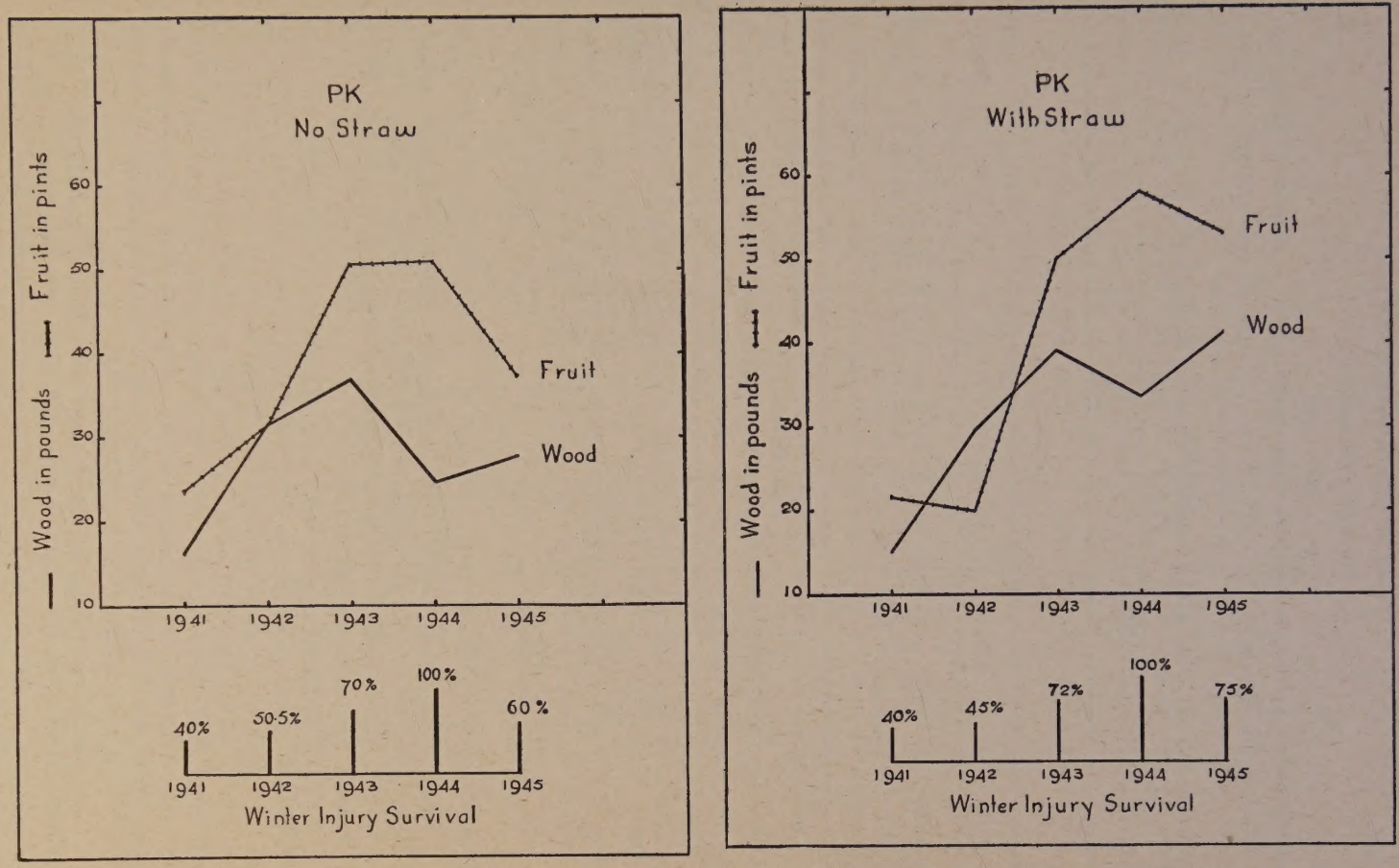


FIGURE 3. Seasonal variations in ratio of wood growth to yield for PK plots, without straw and with straw.

TABLE 7.—FRUIT YIELDS IN PINTS

(Rearranged from Table 5)

1941-42 (*a*)

——	M	N	P	K	NP	NK	PK	NPK
	[1]							
No straw	71.8	43.7	48.5	49.7	56.8	65.1	54.8	54.0
Straw	51.4	22.5	40.6	52.9	26.1	48.6	42.0	25.4
Difference	−20.4	−21.2	− 7.9	+ 3.2	−30.7	−16.5	−12.8	−28.6

Straw applied in the *spring* 1939 to 1942.

1943 (*b*)

——	M	N	P	K	NP	NK	PK	NPK
	[1]							
No straw	48.5	35.6	30.8	38.5	34.6	52.4	50.8	51.0
Straw	48.9	34.4	47.0	60.5	42.7	50.8	50.0	42.2
Difference	+ 0.4	− 1.2	+ 6.2	+22.0	+ 8.1	− 1.6	− 0.8	− 8.8

Straw applied in the *fall* 1943.

1944-1945 (*c*)

——	M	N	P	K	NP	NK	PK	NPK
	[1]							
No straw	99.3	56.8	56.5	62.2	66.4	100.6	88.0	108.7
Straw	74.0	71.3	100.7	113.1	98.5	99.8	111.8	109.3
Difference	−25.3	+14.5	+44.2	+50.9	+32.1	− 0.8	+23.8	+ 0.6

[1] Sums of means of 2 plots.
Straw applied in the *fall* 1944.

Fruit Yields

From yield figures, 1941 to 1945, inclusive (Table 5, sums of means) there appears to be, on the whole, no significant difference between non-straw and straw plots. There are, however, marked differences when treatments are considered separately.

Time of application of straw had a marked effect on yield. In 1941 and 1942 all straw plots except those receiving K were lower in yield than the comparable non-straw plots (Table 7 and Figure 2) but by 1943, the ill effects of spring applications of straw in the preceding years (see Table 4) had practically disappeared. With fall applications in 1943 and 1944 there was a general further improvement in the yield of the straw plots, except in those that received manure. These plots for unknown reasons gave even poorer results than in 1941 and 1942.

The effects on yields, of straw and no straw in conjunction with fertilizer treatments, are also shown in Table 5. On the straw plots the highest yields were obtained when K was used, the next in order being PK, and NK. On the non-straw plots the highest yields occurred with manure,

TABLE 8.—WOOD IN POUNDS

(Rearranged from Table 6)

1941-42 (*a*)

——	M	N	P	K	NP	NK	PK	NPK
	[1]							
No straw	78.6	48.5	59.7	56.4	51.5	71.3	47.4	54.6
Straw	58.1	38.1	54.0	72.3	42.5	52.4	44.4	38.0
Difference	−20.5	−10.4	− 5.7	+15.9	− 9.0	−18.9	− 3.0	−16.6

Straw applied in *spring* 1939 to 1942.

1943 (*b*)

——	M	N	P	K	NP	NK	PK	NPK
	[1]							
No straw	50.0	37.1	30.6	31.7	33.0	44.7	36.9	45.2
Straw	39.6	27.0	44.7	53.8	30.0	43.1	39.2	40.3
Difference	−10.4	−10.1	+14.1	+ 22.1	− 3.0	− 1.6	+ 2.3	− 4.9

Straw applied in the *fall* 1943.

1944-45 (*c*)

——	M	N	P	K	NP	NK	PK	NPK
	[1]							
No straw	71.0	44.2	34.4	43.8	45.4	75.3	52.4	83.0
Straw	59.7	57.2	62.7	83.7	69.4	69.4	75.1	92.3
Difference	−11.3	+13.0	+28.3	+39.9	+24.0	− 5.9	+22.7	+ 9.3

[1] Sums of means of 2 plots.
Straw applied in the *fall* 1944.

NK, and NPK in that order. It should be remembered that manure plots in this experiment were check plots in the first experiment and received no treatment. On the rest of the treatments both with and without straw, yields become progressively less down to the poorest of all, namely, P without straw and N both with and without straw.

On plots receiving manure, N, NK and NPK, respectively, straw depressed yields but on plots treated with P, K, NP and PK straw increased yields, although perhaps not always significantly.

The cost of the large quantities of fertilizer used (Table 3) was undoubtedly out of proportion to the small gains in yield of certain treatments over the manure plots. There is no evidence, however, to show that such large amounts were actually needed for the results obtained.

Size of Fruit

It is doubtful if data of real significance on size of fruit were obtained. There was much variation in number of berries per pint between treatments but it was not consistent. Also there was as much or more variability in

size from season to season as there was between plot treatments in any one year. This lack of consistent data on size of fruit may have been due, partly at least, to faulty sampling. The boxes of berries taken for counting may not have been true samples as it is more than probable that any box could come from one plant only instead of from all the plants in a plot. Also, too few boxes were counted, especially during the later years of the experiment.

Wood Growth—Winter Injury

Results in wood growth were similar to those in yield (Table 6, sum of means, also Table 8 and Figure 2). The ratio between growth and fruitfulness, however, varied considerably both within treatments and from year to year. Seasonal variation is illustrated by the graph, Figure 3. This is for wood and fruit in the PK plots both without and with straw. Other treatments gave similar but not identical patterns. The very high proportion of fruit to wood for 1944 was due primarily to the excellent condition that spring of the fruiting canes, as indicated by the survival rating of 100 per cent—no killing back of fruiting canes.

Incidentally, a low survival rating means that there was much killing back of the canes and consequently much dead wood had to be removed at time of spring pruning. In severe cases the canes were cut down to within one or two feet of the ground instead of the normal three or four feet. This excessive wood removal resulted in fewer fruit-bearing laterals and an increase in the wood weights, as the dead wood was included in the total pruning weights.

Weed Growth

Weed growth varied considerably within treatments although the means for the weed ratings for all plots receiving straw were considerably *higher* than those that had no straw, but as the data are for one year only these results have no real significance. It is suggested, however, that the extra organic matter (straw) added in the spring had increased the water holding capacity of the soil and so favoured late growth of weeds at least, but it was not recorded whether late growth was induced in the raspberry plants. Judging from the winter survival ratings for spring 1942 it would seem that there might have been more winter injury where spring applied straw was used.

Soil Analysis

Two few samples were analysed for phosphorus and potassium to give reliable figures.

Analyses for organic matter gave percentages as shown in Table 9. The figures for organic matter appear to be inconsistent, as one-half of the plots receiving straw gave higher values than those without straw while in the other half the results were reversed.

TABLE 9.—ORGANIC MATTER—PER CENT

Treatment	−Straw	+ Straw
M	1.95[1]	2.29[1]
N	1.68	1.52
P	2.12	2.02
K	1.66	2.06
NP	1.33	2.39
NK	2.26	1.56
PK	2.29	1.62
NPK	1.92	2.03
Means	1.90	1.93

[1] Means of 2 plots each.
(Allison's modification of Schollenberger's "Organic Soil Carbon by Chromic Acid Reduction Method" was used in this analysis.)

SUMMARY

In general *spring* applications of straw depressed yields whereas *fall* applications increased yields.

All mineral (phosphorus and potassium) fertilizer treatments, with straw and without, singly and in combination, with the exception of phosphorus without straw, gave higher yields than nitrogen both with and without straw.

Manure without straw gave yields equal to or better than those obtained with minerals and nitrogen and in one instance only—potassium with straw—was a higher yield obtained.

REFERENCE

1. STRONG, W. J. Results with fertilizers on the red raspberry. Sci. Agr. 16 : 424-439. 1936.

A STUDY OF PARENTAL-PROGENY CORRELATIONS WITH CANADIAN BACON HOGS

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The application of swine progeny records is based on the assumption that the progeny of an animal is indicative of its genetic composition and that the sibs of the progeny should reproduce accordingly. To what extent such sibs follow this concept is naturally dependent on the degree of inheritability or the relative genetic and environmental influence on the factors measured. It is only in more recent years that methods have been proposed (Snedecor, Lush, Dickerson, Hazel, and others) to estimate this relative effect and subsequently predict in part at least the expected results of selection based on progeny records.

The fact that in practice boars are not retained in a herd nearly as long as sows introduces the further problem as to the reliability of using half sibs of the progeny scored instead of full sibs. In other words, a sow is tested by scoring her progeny by a particular boar but whether her future offspring by other boars will reproduce according to this record or how closely such half sibs will reproduce is of particular importance to the practical application of swine progeny records.

With the exception of the study by Lush (1936) of Danish swine progeny records there is little information available on this subject. Several workers have reported individual sire-progeny and dam-progeny associations, but in few cases have the various combinations been compared and none of these with Canadian hog data. This study was instigated as a prerequisite to a swine breeding experiment designed to investigate the inheritance of Canadian bacon hog characteristics being conducted by the Dominion Experimental Farms.

ORIGIN OF DATA

The Canadian Advanced Registry Policy for Swine was inaugurated in 1929 to test pigs through progeny tests of sows and boars. The Policy was outlined in detail by the author (1937) and Peterson (1938). Originally the four pigs which were taken to represent a litter were fed on the premises of the breeder. In 1934 a system of feeding stations (Lefebvre 1938) and (Knox 1938) was started which in latter years has been able to feed out under uniform conditions the majority of the litters tested. In 1939 a change was made in the method of scoring the carcasses of the four pigs. In brief, it changed the scoring of length and back fat, and added a score for eye of lean in the carcass. Hereinafter the original scoring system will be referred to as the "old" score and the 1939 score as the "new" score. This differentiation is very necessary because of the impossibility in a breeding study of making a direct comparison of the two scores and consequently, the necessity of eliminating that part of the population scored under the "old" and concentrating on the "new".

Through the co-operation and assistance of the Advanced Registry officials the records of all the sows tested between 1929 and May 1946 were

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first reviewed. In order to be able to look into the "within dam" variability it was early decided that only groups of two or more full sisters would be used. Thus from the original population of 5500 sows only 1593 were further studied. These made up 655 groups of full sisters, the great majority being groups of two, but there were a few groups of three and four, and two in which five full sister sows had been tested.

The 655 groups were next divided into three classes according to the record of the dam of the full sister groups. Actually the 655 groups represent the same number of different dams. The first class was made up of the groups in which the dam had not been tested. There were 199 groups or dams with 472 daughters in this class. Class II was made up of groups in which the dam had been tested on Advanced Registry but the sire of her tested litter was not the sire of the full sister daughters. In other words, the pigs which were slaughtered and scored to test the dam were half sibs of the daughter group. Two hundred and thirty-four groups with 566 daughters made up Class II. Class III involving 222 groups with 555 daughters was made up of the groups in which the dams had been tested and the sire of their test pigs was also the sire of the daughter groups. Actually, the test pigs were full sibs of the daughter groups, in some cases litter mates and in others from another litter of the same mating.

The next step in organizing the data was to study the record of the boar to which each of the full sister groups was bred to make their carcass test. It was immediately apparent that, in many cases where two full sisters were tested, they had been bred to different boars and in order to later be able to analyse a "within boar" variability the groups in which different boars were used were discarded. This materially reduced the population but left it made up of groups of two or more tested full sisters bred to the same boar.

The only record of the boars available was that of their dams, and they divided themselves into the same three classes as the dams of the full sisters, *viz.* (a) not tested, (b) tested but not to the sire of the boar, and (c) tested with the same mating that produced the boar.

Taking into consideration the method of scoring and eliminating the groups which were not scored on a comparable basis, the population was now as follows:—

CLASS I. Dam of group not tested

	Number dams		Number daughters	
	Old score	New score	Old score	New score
(a) Dam of boar not tested	40	27	102	60
(b) Dam of boar tested, not same mating	3	15	6	33
(c) Dam of boar tested, same mating	6	10	13	21

CLASS II. Dam of group tested not same mating

(a) Dam of boar not tested	15	16	36	34
(b) Dam of boar tested not same mating	—	15	—	32
(c) Dam of boar tested same mating	—	16	—	34

CLASS III. Dam of group tested same mating

	Number dams		Number daughters	
	Old score	New score	Old score	New score
(a) Dam of boar not tested	15	11	37	25
(b) Dam of boar tested not same mating	3	14	6	32
(c) Dam of boar tested same mating	4	14	10	30

The only apparent reason that there were no groups in Class II (b) and (c) tested under the old score was the fact that a far higher percentage was eliminated in these two, due to the dams being scored under the old and the daughters under the new score, than with any other sub-classes.

As there was no record of either or both the maternal and paternal ancestors in Class I (a), (b), (c), Class II (a) and Class III (a) they could be of no further use in this study of parental and progeny records.

In Class II (b) and (c), and Class III (b) and (c) where both the parents of the test pigs of the full sister groups had records, either of full sibs or half sibs, these sub-classes were further studied by compiling the average scores and measurements of parent and progeny test pigs, investigating the variability in certain carcass characteristics, calculating the correlations between parent and progeny, and estimating through variance, covariance, and regression the degree of inheritability of certain carcass factors.

Certain unnecessary detail of the origin of the data was included here for three reasons: (1) The meagre information available on this subject; (2) The difficulties allied with the organization of comparable data of this nature, with the accompanying limitations to the interpretation of the results of its analysis, and (3) The handicaps encountered in using data from a public policy with a comparative wide latitude or personal application rather than having available information from a designed breeding experiment.

THE USE OF A.R. RECORDS

In subdividing the groups of two or more full sisters which have been tested in the Advanced Registry for Swine in Canada according to to their dam's record, approximately one-third were from dams whose tested litter was sired by the same boar as the full sister group, that is, the four pigs which were slaughtered and scored to test the dam were full sibs (full brothers or sisters) of the group of two or more daughters later tested. Another third were from dams which had been tested but by a litter sired by a boar other than the sire of the sister group. The dams of the remaining third had not been tested.

This same distribution was encountered when the record of the dams of the boars to which the full sister groups were mated for their test was examined. One-third of the dams of the boars had been tested with full sibs of the boars, one-third with half sibs, and the remainder had not been tested.

If all the sows tested in the last five years, for instance, had been examined with regard to their dam's record rather than just the group of

two or more full sisters, this picture of the use of A.R. records might not have been the same. On the other hand, if the full sister groups can be taken as representative it is indicated that only two-thirds of the stock selected by A.R. breeders is backed by testing, and only one-half of that selected from tested matings. It is admitted that the A.R. policy is comparatively new, and quite possibly some of the groups of sisters without backing were tested by breeders new to testing.

Even allowing for these latter, who would have had no chance to have had records behind their selections unless they had been purchased, it would seem that if the scoring followed in the Advanced Registry Policy is a sound measure of the genotype of breeding stock, and if a wider distribution of tested stock is to be accomplished, then breeders should select more from tested ancestors and particularly pigs from matings that have been tested.

PARENTAL SIBS AND PROGENY AVERAGES

In order to study the population from the standpoint of any trends that may have taken place between parent and progeny, the carcass measurements were averaged. The sire and dam sib averages were first computed separately, but as the same general differences were apparent between both parental sibs and offspring the former were put together to make one parental average. In Table 1 this is compared with the progeny mean for the various characteristics and the differences (progeny-parent) between the two are shown for the four combinations of parental relationships as well as the general total.

TABLE 1.—COMPARISON OF CARCASS MEASUREMENTS OF PROGENY WITH SIRE AND DAM SIBS

Item	Progeny mean minus the mean of					General mean	
	Sire and dam's full sibs	Sire's half sibs and dam's full sibs	Sire's full sibs and dam's half sibs	Sire and dam's half sibs	Total parental sibs	Sire and dam's sibs	Progeny
Number of parental sib carcasses	112	112	128	120	472	472	—
Number of progeny carcasses	120	128	136	128	512	—	512
Age in days	2.6	5.5	4.4	−6.2	1.6	191.4	193.0
Cold carcass weight	−1.2	.5	− .3	−1.6	−.7	149.6	148.9
Maturity index	−1.9	−2.5	−2.6	2.7	−1.1	105.0	103.9
Length	.01	−.37	−.30	−.13	−.20	30.87	30.67
Shoulder fat	.03	.03	.04	.06	.04	1.79	1.83
Back fat	−.03	.02	−.01	.04	.01	1.04	1.05
Loin fat	.02	.03	.01	.03	.02	1.40	1.42
Per cent ham	.21	−.19	.15	−.29	−.02	24.20	24.18
Per cent middle	.19	.76	−.02	.47	.34	47.82	48.16
Per cent shoulder	−.40	−.57	−.13	−.19	−.32	27.98	27.66
Belly grade[1]	.26	.01	.07	.63	.25	2.81	3.06
Fat firmness[1]	−.09	−.22	.03	.01	−.06	1.59	1.53
Area loin	.09	−.02	.19.	.07	.09	5.04	5.13
Score	−.45	−.22	−.66	−.92	−.56	79.69	79.13

[1] Coded—high values indicate low quality. Thus, plus value indicates deterioration in the factor.

Other than the slight bias toward the upper level of the general population of Canadian tested hogs introduced by the selection of groups of two or more daughters from tested dams, there is nothing to indicate that these data are not representative. Because of this bias, however, it might be as well to refer to the population as representative of above average hogs or hogs with which considerable selection had been practised. As such there are several very interesting and quite consistent trends as between the averages of the sibs of the parents and the progeny.

It is indicated that maturity index, length, per cent shoulder, and carcass score have decreased, while shoulder fat, loin fat, per cent middle, and area of loin have increased. It is also indicated that the quality of bellies has deteriorated. Previous studies (Stothart 1937, 1938) indicated that certain of these trends are correlated, particularly the positive increase in fat and per cent middle, although the increased loin along with the extra fat is contrary to that previously reported. With the exception of the increased loin the other trends, especially the decreased length and increased fat, would bring about the decreased score.

These same adverse trends in the general population of tested hogs in Canada were recognized by the Advanced Registry Board in 1946, and adjustments were made in the score to focus attention on them.

With the exception of the differences in average length there is little to indicate a closer agreement in Table 1 between parental full sibs and progeny as against half sibs and progeny. On the whole, the same general differences are apparent in all four comparisons. The consistency of these differences would also lead to the conclusion that either any selection for improvement that has been practised has been ineffective, or that the level of the parents was already so high that there was a regression toward the mean.

PARENT-PROGENY CORRELATIONS

Because of the unequal observations for parent and progeny, (*viz.* only four pigs were representative of either sire or dam, while eight were available for the progeny in 51 cases, 12 in six, and 16 in the two groups where four full sister litter groups were tested), the correlations were calculated from the differences between the means of the groups. With the individual parent-progeny figures it was possible to combine the classes where the records for either parental full or half sibs were available. Thus, the observations in Class III (c) for dam's full sibs and progeny could be added to Class III (b) where the same comparison was present. Likewise, Class II (c) and II (b) dam's half sibs; III (c) and II (c) sire's full sibs; and III (b) and II (b) sire's half sibs, were combined.

When the correlations between the averages of sire and dam and progeny were calculated the numbers available were only the number of groups in the four combinations of parental sibs. These correlation coefficients, as well as those for total between dam's sibs, sire's sibs and the average of the two and progeny, regardless of parental relationship, are shown in Table 2.

It is immediately apparent in studying the correlations in maturity index, which is a measure of weight for age based on a 150 pound carcass at 200 days of age, that the influence of the dam on the rate of growth of

TABLE 2.—CORRELATIONS BETWEEN DAM-PROGENY; SIRE-PROGENY; AND AVERAGE OF DAM AND SIRE-PROGENY

(Regression of progeny on parent in brackets)

Correlation between progeny and:	D/F	Maturity index	Carcass score	Length	Back fat	Area of loin
Dam's full sibs	27	.39	.27	.13	.28	.06
Dam's half sibs	30	.34	.39	.56	.28	.28
Dam's sibs	58	.36	.33	.35	.28	.21
Sire's full sibs	29	.21	.05	.14	.18	−.29
Sire's half sibs	28	−.09	.20	.27	.27	.26
Sire's sibs	58	.03	.13	.21	.26	−.03
Av. sire and dam's full sibs	13	.37	.14	.13	.38	−.33
Av. sire's half and dam's full sibs	13	.14	.60	.30	.40	.21
Av. sire's full and dam's half sibs	15	.63	.00	.56	.02	−.38
Av. sire and dam's half sibs	14	.04	.11	.47	.40	.59
Av. sire and dam's sibs	58	.23 (.27)	.32 (.35)	.37 (.42)	.36 (.37)	.12 (.16)

With 13 degrees of freedom "r" necessary with P at .05 = .514, at .01 = .641.
With 27 degrees of freedom "r" necessary with P at .05 = .367, at .01 = .470.
With 58 degrees of freedom "r" necessary with P at .05 = .250, at .01 = .325.

the progeny is greater than that of the sire. All three correlations between dam's sibs and progeny either approach or exceed the .05 point in significance, while those between sire and progeny show no significance. It is possible, however, that some of this relationship at least is due to the fact that the dam's sibs and progeny would have more often been tested under the same environmental conditions than sire sibs and progeny.

While there is some indication of a stronger association between parental full sibs and progeny than half sibs in maturity index, this is the only characteristic in which it is apparent. In fact, the reverse seems to be indicated in certain of the other factors. There is one explanation that might account for this result. These data are taken from a wide range of conditions across the Dominion, and breeders generally retain replacement stock from qualified sows. The fact that the offspring (full sibs) from an unqualified sow might be sold and therefore be raised under different environmental conditions before the record of the sow is available, might influence the parent-progeny comparison as against later half-sib offspring retained on the breeder's premises and raised and tested under much the same environment as the parents.

Further evidence of this is apparent later (Table 3) where it is indicated that the relative genetic influence is higher with maturity index than in the other factors, and the parental effect would, therefore, express itself regardless of environment. Also, the general stronger association of dam with progeny than sire with progeny would support this explanation because of the fact that sires are generally procured from outside a breeder's herd.

While there is considerable inconsistency in the correlations of the smaller groups, possibly because of the small numbers, the coefficients for the average of the sire and dam sibs and progeny are in the main significant. The notable exception is that for area of loin, a measurement taken to indicate proportion of lean to fat in the carcass. With maturity index the coefficient only approaches significance, but with carcass score, length of side, and depth of back fat, the correlations are highly significant and indicate that the average measurements of the parental sibs should be indicative of progeny performance.

Unfortunately, these data did not allow of an analysis as between years or between Stations because parental and progeny litter groups were seldom tested in the same year or at any specific time interval nor were they necessarily fed under the same conditions. In some cases both groups were fed at the feeding stations, but in others both were fed at home or one at home and the other at a station. All groups, however, were slaughtered, measured, and scored following the standard A.R. procedure. This absence of control over environmental background makes it difficult to use the correlations or regressions to make an estimate of heritability. Lush (1940) intimates that to the extent a correlation between parent and progeny is due to both being raised in the same environment it does not indicate heritability. On the other hand, the randomization of the data may permit the estimation of heritability. If such is the case, as Stonaker and Lush (1942) take the regression coefficient of a pig on a single parent, the dam, to represent half the genetic variance, the regressions (shown in brackets) in Table 2 of progeny on the average of both parents should give a good measure of the total genetic fraction of the variance between sets of parental sibs, except in as much as part of the regression may have been due to environment which was alike for parental sibs and progeny.

With this proviso in mind, the regressions of the significant associations in Table 2 indicate that the heritability of carcass score is 35 per cent, length of side 42, and back fat 37 per cent. In other words, for example, with parents averaging 10 points above the average of the general population in carcass score, the average score of the pigs could be expected to increase 3.5 points per generation over the general population if selection were made for this factor alone.

It should also be kept in mind that these estimates of heritability are for averages of parental sibs and not for variation between individual pigs. Estimates based on the latter might be expected to be lower as the use of averages would tend to reduce the non-genetic variations.

RELATIVE GENETIC AND ENVIRONMENTAL INFLUENCE

Following the procedure proposed by Stonaker and Lush (1942) and Hetzer, Dickerson, and Zeller (1944) and others, the analysis of variance described by Snedecor (1940) was employed to determine the relative importance of differences (A) between sires, which in this study would include genetic differences as well as any due to unrandomized environmental effects of the conditions under which the pigs were fed and seasonal differences; (B) between litters by the same sire, which is actually between full sisters, as only groups of full sisters bred to the same boar were used.

These would include genetic differences due to the pigs being sibs, but not litter mates, and the environmental differences affecting litters but not litter mates. Any effects of differences in the nursing ability of full sisters would be included here; and (C) within litters or between litter mates, which in addition to any genetic differences between litter mates and the effect of environmental differences between them would include any effects of difference generally described as error or unmeasurable.

As intimated earlier, the data did not allow a more detailed analysis, such as between stations, between years within stations, between sires within station and year, etc., and consequently, it is difficult to differentiate between the genetic and environmental effects. There is also the fact that certain results may be due to a combination of both heredity and environment and cannot be partitioned mathematically. In general, however, it would seem that the majority of the "between litter mates" variance could be attributed to environment and that for between sires and between full sisters to genetic differences. This may not apply with certain characteristics in which there is considerable interaction of hereditary and environmental factors.

The summary of the relative importance of these differences with maturity index, carcass score, length of side, minimum back fat, and area of loin are presented in Table 3. The data from 59 sires with 128 litters of four pigs each were used. The percentages shown are of the total of A, B, and C after these had been calculated from the mean squares.

TABLE 3.—ANALYSIS OF VARIANCE SHOWING THE PERCENTAGE DUE TO DIFFERENT CAUSES

Source	D/F	Composition of mean square	Percentage due to different causes				
			Maturity index	Carcass score	Length	Back fat	Area of loin
			%	%	%	%	%
Total	511						
Between sires	58	$C + \frac{512}{128} B + \frac{512}{59} A$	33.8	13.6	29.4	23.4	31.2
Between litters by the same sire (between full sisters)	69	$C + \frac{512}{128} B$	21.2**	5.5	10.4**	16.8**	6.3*
Within litters (between pigs)	384	C	45.0	80.9	60.2	59.8	62.5

* Mean square significant over the "within litter" variance with P = .05.
** Mean square significant over the "within litter" variance with P = .01.

The differences due to between full sisters as indicated by the mean squares from which the percentage figures were calculated in Table 3 are highly significant over the within litter variance for maturity index, length, and minimum back fat. Those for area of loin are significant at the five per cent level, but for carcass score they are not significantly greater than the between pig variance.

In maturity index this significant difference between full sisters is evidence of differences in nursing ability, health and general ability to wean strong, healthy pigs which in turn are reflected in the later growth rate of the market pigs.

Although the differences due to between sires is highly significant in all cases over those due to between pigs, the latter is not (Dickerson 1947) the proper error mean square to test significance in this case because of the station and seasonal differences which may be included in the sire differences. The between litters by the same sire variance is also too small to measure sire differences in this case because of the fact that it is only differences between full sisters, while the sows bred to different boars would tend to be unrelated.

If the between sire and between full sister differences in certain characteristics can be taken to be in the main genetic, as suggested in the introduction to Table 3, it is indicated that the relative influence of heredity and environment on the individual carcass measurements is quite consistent. In each the between pig differences (environment) approximate 60 per cent. With length and back fat the total of the between sire and between full sister differences are 39.8 and 40.0 per cent, respectively, which agree quite closely with the estimates of heritability of 42 and 37 per cent shown by the regressions of progeny on the average of sire and dam sibs for these measurements.

With carcass score, on the other hand, the environmental effect is materially increased in this estimate, and although this single factor is by all odds the best to work with in selection, it is indicated that it is only about 19 per cent influenced by genetic factors. Stonaker and Lush (1942) report that 20 per cent of the variance within line and season in conformation of swine at 225 pounds, as measured by a scoring system, was due to differences in the additive effects of their genes. It would seem likely that somewhere between the 19 per cent here reported and the 35 previously shown in the regression of progeny on the average of the parents would be applicable to Canadian hogs. The fact that there are several specific environmental influences such as feed, the feeder, weight the pig is marketed, etc., as well as the mechanics of scoring of the several characteristics, which can affect the carcass score would explain the relatively lower genetic influence in this factor as compared to that for an individual measurement. The effect of scoring should, of course, be negligible but where a scoring system is based on weight ranges and a carcass weighing 144½ pounds, for instance, would get a slightly different score than one of 145 pounds, certain mechanical variation would be introduced.

With maturity index, weight for age, the relative importance of the different sources of variance are shown to be 33.8 per cent for between sires, 21.2 between full sisters, and 45.0 between pigs. The nature of this measurement, however, would suggest that environment might have a greater influence than would be indicated if the same portioning of genetic and environment effects were followed as with the carcass measurements.

In the 1937 study there was no significance in the correlation reported between carcass score and maturity index. That was calculated with the "old" carcass score. The same result, that is, no evidence of an association between speed of growth and carcass excellence, was obtained with these data.

SUMMARY

The correlations between the individual and average parental full sibs, parental half sibs, and progeny in maturity index, carcass score, length, back fat, and area of loin were studied with Canadian bacon hogs tested under the Advanced Registry Policy.

In practice, on the basis of the groups of two or more full sister sows tested under the Advanced Registry Policy for Swine, Canadian breeders are selecting about one-third of their replacement stock with full sib records, that is, from tested matings, one-third with half sib records, and the remainder with no record.

There was no indication of any stronger association in simple correlation between parental full as against half sibs and progeny, but it is suggested that the former would more often be sold and raised under different environmental conditions than the latter, which would result from mating the sow to different boars after she had qualified.

The regressions of progeny on the average of sire and dam sibs indicated carcass score was 35 per cent, length 42, and back fat 37 per cent heritable.

Close agreement with these estimates was obtained for the individual carcass measurements by portioning the analysis of variance into genetic and environmental influence. The variance due to genetic factors in carcass score was lower.

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REFERENCES

1. Dickerson, G. E. Regional Swine Breeding Laboratory, Ames, Ia. Correspondence. 1947.
2. Hetzer, H. O., G. E. Dickerson, and J. H. Zeller. Heritability of type in Poland China swine as evaluated by scoring. Jour. An. Sci. 3 : 390-398. 1944.
3. Knox, R. G. Test station operation. Sci. Ag. 19 : 143-146. 1938.
4. Lefebvre, J. G. Results of station testing in Canada. Sci. Ag. 19 : 147-154. 1938.
5. Lush, Jay L. Genetic aspects of the Danish system of progeny-testing swine. Ia. Ag. Exp. Sta., Res. Bul. 204. 1936.
6. Lush, Jay L. Intra-sire correlations or regressions of offspring on dam as a method of estimating heritability of characteristics. Proc. Am. Soc. An. Prod. 33rd Annual Meeting: 293-301. 1940.
7. Peterson, A. W. Advanced Registry for pure bred swine. Sci. Ag. 19 : 139-142. 1938.
8. Snedecor, George W. Statistical Methods. Ed. 3, 422 pp. illus. Iowa State College Press, Ames, Ia. 1940.
9. Stonaker, H. H., and J. L. Lush. Heritability of conformation in Poland China swine as evaluated by scoring. Jour. An. Sci. 1 : 99-105. 1942.
10. Stothart, J. G. An analysis of swine progeny records. Dominion of Canada, Dept. of Ag., Pub. 550, Tech. Bul. 6. 1937.
11. Stothart, J. G. A study of factors influencing swine carcass measurements. Sci. Ag. 19 : 162-172. 1938.

THE GENUS CASINARIA HOLMGREN IN AMERICA NORTH OF MEXICO (HYMEN., ICHNEUMONIDAE)[1]

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This paper consists of a systematic account of the species of *Casinaria* which are known to occur in America north of Mexico. The genus is here recognized in the sense in which it has recently been redefined by Townes (Bol. de Ent. Venezolana, V, No. 2, p. 62, 1946), and thus includes all the species assigned to *Charops* Holmg. in the Townes Catalogue of Nearctic Ichneumonidae (Mem. Am. Ent. Soc. No. 11, Pt. II, 607, 1945), except *Charops annulipes* Ashm. In addition it also contains ten species and one subspecies herein described as new, making a total of nineteen species and one subspecies for the territory considered.

This study is based on material contained in the Canadian National Collection, supplemented by numerous specimens loaned by the several museums and individuals noted below. Much of the material in the National Collection has been provided by officers of the Forest Insects Unit of the Division of Entomology, and consists of specimens reared from a number of species of lepidoptera which are injurious to forest trees in Canada. From the data now available it seems evident that several species of the genus *Casinaria* play an important rôle in the economy of these pests and this study was undertaken in part to provide a more satisfactory means of identifying such material. The scope of this study has also been greatly increased by the loan of much valuable material from the collections of the United States National Museum. In this connection I am especially indebted to Mr. R. A. Cushman, formerly of the United States Bureau of Entomology and Plant Quarantine, for his kindness in supplying specimens and for many helpful notes concerning type material in his custody. More recently Dr. H. K. Townes has also aided in the same capacities and in addition has provided numerous specimens for study from his extensive private collection of Ichneumonidae. Dr. Edward S. Ross, Associate Curator of Insects at the California Academy of Sciences, has also supplied specimens from the collections in his charge, and the following workers have generously responded by loaning material from their private collections: Mr. R. R. Driesbach, Midland, Mich., Mr. R. T. Mitchell, Bowie, Md., and Mr. Hewson Swift, University of Iowa, Iowa City, Ia. To all these individuals I wish to express my sincere appreciation. I am also grateful to my colleague Dr. O. Peck who has assisted at various times during the course of preparation of this paper by giving consultation and helpful criticism concerning many details.

Family Ichneumonidae
Subfamily Ophioninae
Tribe Campoplegini
Genus CASINARIA Holmgren

As restricted by Townes, in 1946, this genus includes as synonyms *Amorphota*, *Campotrephus*, *Alcima*, *Anempheres*, *Trophocampa*, *Fiebrigia*, *Neonortonia*, *Zastenomorpha* and *Zastenogastra*. Bibliographic data for these genera, with their respective genotypes, are listed in the Townes

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Catalogue and are therefore omitted here. In the course of the present study I have examined examples of the genotype of each genus mentioned above, except *Trophocampa*, and am in agreement with the synonymy given by Townes. It may be remarked that several of the genera included in the synonymy represent rather distinct elements within the genus *Casinaria* and might accordingly be adopted as subgeneric categories. Such a course would logically entail the erection of additional subgenera for other equally distinct groups resulting in the employment of a relatively large number of subgenera for the reception of a comparatively small number of species. The advantages of such a procedure are not apparent to the writer and accordingly it is preferred to divide the genus into a a number of species groups which appear to be more or less natural aggregations of species which together form one large natural group.

The genus *Casinaria* has long been regarded as closely allied to *Charops* Holmg. This latter genus is represented in our territory by a single species, *Charops annulipes* Ashm. This species is in many respects very different from the genotype of *Charops (Campoplex decipiens* Grav.) which is an European species, but nevertheless shares with it certain characters which will serve to differentiate between *Charops* and *Casinaria*. The principal distinctions between these two genera have been tabulated by Townes (Bol. de Ent. Venezolana V, No. 2, p. 61, 1946) as follows:

Central 0.3 or more of mesopleural suture not impressed, indicated only by the raised epimeron and by transverse rugae; extreme basal part of petiole with sternite occupying its entire depth, so that in side view its lateral suture runs along the upper margin of the petiole; areolet absent (except in an Oriental species group); outer lower angle of second discoidal cell a right angle (slightly acute in an Oriental species group); propodeal spiracle more than 2.0 as long as wide; squama of male genitalia usually rod-like apically..... *Charops*

Central 0.3 of mesopleural suture impressed as a sharp shallow groove; extreme base of petiole with sternite not occupying quite its entire depth, so that in side view its lateral suture is a little below the upper edge of the petiole; areolet present; outer lower angle of second discoidal cell acute (rarely a right angle [or slightly obtuse]); propodeal spiracle less than 2.0 as long as wide (except in *texana* [= *grandis*] and related species); squama of male genitalia not rod-like apically..... *Casinaria*

In addition to *Charops* and *Casinaria* the tribe Campoplegini contains several other genera which while probably not especially closely allied agree in having the propodeum produced posteriorly distinctly beyond the base of the hind coxa. In this respect they are more or less likely to be confused with *Casinaria* and accordingly they are discussed briefly below with the object of pointing out their principal distinctions.

Idechthis Foer.—This genus is probably fairly closely related to *Casinaria* with which it agrees in the form of the petiolar segment. It differs in having the eye only very feebly emarginate opposite the antenna, the clypeus broad with its margin not impressed and the sheath in the female at least a little longer than the first abdominal tergite. The male is also distinctive in the form of the clasper, the upper margin of which is shallowly excised near the apex with the upper posterior angle acute.

Campoplegidea Vier.—This genus resembles *Casinaria* especially in having the eye distinctly emarginate opposite the antenna and the propodeum incompletely areolate and with a median longitudinal sulcus. It differs in having the clypeus broad with its margin not impressed and the propodeal spiracle usually more than twice as long as broad.

Campoctonus Vier.—This genus agrees with *Casinaria* in having the eye distinctly emarginate opposite the antenna and the clypeus narrow with its margin sharply impressed. It differs notably in the form of the propodeum which is convex and lacks a median longitudinal sulcus; it also differs in the form of the petiolar segment which is slightly decurved and bears a small fovea on either side some distance anterior to the spiracle. In addition the female differs in the much longer sheath and the rather strongly upcurved ovipositor.

Campoplex Grav.—This genus contains a diversity of forms including a few species in which the propodeum is produced considerably beyond the base of the hind coxa. These are best distinguished from *Casinaria* by the broader clypeus which has the margin unimpressed and by the absence of a distinct emargination of the eye opposite the antenna, also in the female by the much longer sheath which extends distinctly beyond the apex of the abdomen.

Horogenes Foer.—In a few species in this genus the abdomen is rather strongly compressed and the propodeum extends for some distance beyond the base of the hind coxa but these may be easily separated from *Casinaria* by the scarcely emarginate eyes, the much longer sheath in the female and especially by the presence of a distinct impression or fovea on each side of the petiole anterior to the spiracle.

DESCRIPTION OF GENUS

Length 6–15 mm.; antenna a little shorter than body.

Head transverse, often lenticular, more rarely somewhat thickened; eyes large, not hairy, distinctly emarginate opposite antennae; clypeus usually rather narrow with margin broadly convex and narrowly impressed, but sometimes (*ambigua* and *scabriformis* groups) broader with margin truncate and more broadly impressed; mandible usually short (excluding teeth, often not or only slightly longer than its greatest breadth), more rarely (*infesta* group) distincly longer than broad, lower margin with a well developed flange; occipital carina usually joining hypostomal carina close to base of mandible, but sometimes (as in *scabriformis* and *geometrae* groups) evanescent below so that it fails to extend to the hypostomal carina; antenna filiform, slight y thickened in region of middle of flagellum; ocelli of moderate size; ocellocular space varying from one-third to one and one-fourth the diameter of a lateral ocellus; malar space varying from one-fourth to approximately seven-tenths the basal width of mandible.

Thorax moderately broad, pronotum rather short, so that the head appears rather closely appressed to the thorax; mesoscutum convex; notaulices absent or indicated only by short shallow impressions anteriorly; mesoscutum and scutellum opaque, finely granular and usually densely punctured; disk of scutellum usually convex, rarely *(grandis)* strongly flattened and with a median impression, sternaulus present or absent, mesopleural suture impressed as a sharp shallow groove throughout its length; propodeum usually rather strongly narrowed from the base, with apex extending at least beyond the basal one-third of dorsal surface of hind coxa, sometimes with apex extending almost to apex of hind coxa; propo-

deum usually with a distinct moderately broad median longitudinal sulcus, occasionally with sulcus indistinct (*vadosa*), or very shallow and very broad (*pinguis*) in the latter case the propodeum also very broad and scarcely narrowed in the basal two-thirds; propodeum never completely areolate, frequently with an incomplete basal transverse carina and more or less distinct longitudinal carinae which are usually incomplete and more or less irregular but sometimes (*scabriformis* and *geometrae* groups) complete and regular; propodeal spiracle oval or elliptical, usually less than twice as long as wide.

Wings moderately large; stigma narrow; areolet small, usually petiolate, rarely broadly sessile (*ambigua*); outer posterior angle of second discoidal cell usually acute, more rarely slightly obtuse (*pinguis*).

Abdomen narrowly petiolate; petiole without lateral groove or fovea; lateral suture of petiole at least a little below the upper edge of petiole even at extreme base (*i.e.* in lateral aspect the sternite never occupying the entire depth of the petiole); post-petiole distinctly expanded; second tergite usually much longer than broad at apex, rarely (*pinguis*) only slightly longer than broad at apex; lateral margin of third tergite narrowly inflexed; abdomen beyond the base more or less, often strongly, compressed; sheath usually shorter than depth of abdomen at apex, rarely (*infesta* group) slightly longer.

Head and thorax black; abdomen varying from almost entirely reddish to uniformly black; legs generally mostly reddish, but sometimes largely black, usually more or less marked with pale yellowish, the hind tibia frequently blackish with a yellowish stripe on upper surface; wings usually hyaline or with a slight fuscous tinge, occasionally (*grandis*) pale brownish.

CLASSIFICATION AND TERMS

In this synopsis the genus is divided into seven species groups and the key is arranged so as to express their principal characteristics. The groups appear to be natural but their arrangement here is largely arbitrary. Certain species have rather characteristic host relationships and there is is also some evidence that the characters exhibited in the cocoons of some species are of value in classification. Unfortunately data in these respects are lacking for a number of species. Structural characters of particular value in defining groups of species are found in the form of the clypeus, mandible, occipital carina, scutellum, areolet, second discoidal cell, propodeum and its carinae, and in the shape of the abdomen. The species may be distinguished by a great variety of characters found in structures in nearly all regions of the body, and also by differences in colour, particularly the colour of the mandibles, tegulae, legs and abdomen. Occasionally (*limenitidis* group) differences in the structure of the male genitalia are of value in distinguishing between otherwise very similar species. Also in the *limenitidis* group it has been found convenient to distinguish the females of certain species by the proportions of the face. In such instances the width of the face is measured at the narrowest point between the eyes and is expressed as a factor (percentage) of the combined lengths of the face and clypeus, the latter measurement being the distance from level of the lower margins of the antennal sockets to the margin of the clypeus.

KEY TO SPECIES

1. Areolet pentagonal, broadly sessile above; malar space about four-fifths as broad as basal width of mandible; margin of clypeus truncate; longitudinal carinae developed only on basal and apical portions of propodeum; petiole unusually short and stout, its tergite with a weak dorso-lateral flange at the extensor muscle attachment (*ambigua* group).....*ambigua* (Tow.)

   Areolet in the form of a trapezium, or with one side so reduced as to be virtually triangular, frequently petiolate above; malar space one-fourth to two-thirds as broad as basal width of mandible; margin of clypeus convex, or if broadly truncate (*scabriformis* group) then propodeum with complete longitudinal carinae; longitudinal propodeal carinae absent, incomplete, or fully developed; petiole not unusually short and stout (moderately stout in *pinguis* group), usually rather long and slender.....2

2. Clypeus broad, its margin squarely truncate or slightly concave and rather broadly impressed especially in lateral regions; propodeum short, rather finely sculptured, median longitudinal carinae complete, regular and distinct; occipital carina incomplete, on either side, not uniting with the hypostomal carina; the latter only moderately elevated; small species (length about 6 mm.) with abdomen rather stout and only slightly compressed; mandibles yellow (*scabriformis* group)....3

   Clypeus less broad, its margin never squarely truncate or slightly concave, usually distinctly convex (in doubtful cases never with propodeal carinae and occipital carina as described above); propodeum with median longitudinal carinae usually incomplete and irregular, sometimes almost entirely absent, if however regular and complete (as in the *geometrae* group) then the clypeus is especially narrow, with the margin distinctly convex, and the mandibles are entirely dark brown or blackish; occipital carina complete, or if incomplete (*geometrae* group) then the hypostomal carina very strongly elevated and more or less reflexed; size variable; abdomen sometimes strongly compressed.....6

3. Lower portion of temple flattened and not receding for a considerable distance posterior to eye, then very sharply rounded to occiput, the angular edge thus produced simulating the true occipital carina which lies beyond nearer the median axis of the body.....*coloradensis* n. sp.

   Lower portion of temple more or less receding and rounded behind, not sharply angular in the posterior region.....4

4. Antenna usually 29–34 segmented, in female with shortest segments of flagellum a little longer than broad; ocellocular space not greater than one-half diameter of lateral ocellus; malar space about one-fourth as broad as basal width of mandible; mesoscutum finely granular and with fairly distinct punctures; hind tibia rather contrastingly coloured, with a more or less distinct incomplete pale median band *semiothisae* Wly.

   Antenna usually 25–28 segmented, in female with shortest segments of flagellum fully as broad as long; ocellocular space usually at least two-thirds diameter of lateral ocellus; malar space a little broader than above; mesoscutum with more indistinct punctures obscured by granular sculpture; hind tibia less conspicuously banded..5

5. Abdominal tergites uniformly black.....*eupitheciae* Vier.
   Abdomen beyond middle of third tergite largely or entirely reddish..*scabriformis* Vier.

6. Scutellum very large, broad and distinctly flattened, the central portion concave; temple flat, very strongly receding; vertex descending perpendicularly immediately behind lateral ocelli; thorax and propodeum with unusually coarse sculpture; propodeum without carinae; abdomen strongly compressed; areolet small, petiole very long; large species (length about 15 mm.) (*grandis* group)..*grandis* new name

   Scutellum smaller, and always distinctly convex; in other respects never with above combination of characters.....7

7. Propodeum with a pair of regular, distinct, widely separated, median longitudinal carinae; occipital carina evanescent near hypostome; hypostomal carina strongly elevated, lamelliform; gena sometimes with a more or less distinct impression close to hypostomal carina; sternaulus usually broad and distinct; mandible black or brownish-black except at apex (*geometrae* group).....8

   Propodeum without longitudinal carinae, or if present they are rather irregular and incomplete (in doubtful cases the occipital carina extending to hypostomal carina and the latter only moderately elevated); gena without an impression; sternaulus very weak or absent; mandible varying in colour, often largely yellowish.....11

8. Temple almost flat, very strongly receding; scutellum and propodeum with unusually dense, conspicuous, brownish vestiture; wing distinctly tinged with brown; abdomen reddish at apex ..... *tenuiceps* n. sp.
   Temple distinctly convex, less strongly receding; scutellum and propodeum with normal, rather inconspicuous vestiture; wing not distinctly tinged with brown, or if so (as in *geometrae occidentalis*) then abdomen with two or three apical tergites black 9

9. Gena with a large, strongly impressed area or recess near base of mandible and adjacent hypostomal carina, the height of latter thus accentuated in this region. *cavigena* n. sp.
   Gena without such modification, at most with a slight impression; hypostomal carina less strongly elevated (*geometrae*) 10

10. Tegula yellowish (in occasional examples light brownish); female with abdomen uniformly reddish at apex; middle and hind femora dull reddish or rufopiceous (rarely virtually black); temple in female moderately convex, distinctly receding *geometrae geometrae* n. subsp.
    Tegula usually dark brown to black; female with two or three apical abdominal tergites black; middle and hind femora black; temple in female rather strongly convex; only slightly receding ..... *geometrae occidentalis* n. subsp.

11. Temple moderately receding; clypeus rather broad, only slightly narrower than face, malar space unusually narrow, approximately one-fourth as broad as basal width of mandible; mandible distinctly longer than broad, lamina only moderately developed and terminating distally in a long gradual decline; face coarsely sculptured and rather shining; speculum unusually large and polished; abdomen strongly compressed; sheath rather long, extending distinctly beyond apex of abdomen; greater part of scape, and usually the pedicel beneath, yellow; post-petiole, more or less of second and third tergites, and all tergites beyond, reddish (*infesta* group) 12
    Never with the above combination of characters 13

12. Trochanters of middle and hind legs yellowish or reddish, rarely the base of hind trochanter brownish; middle and hind femora reddish ..... *infesta* (Cress.)
    Trochanters of middle and hind legs blackish; middle and hind femora black (rarely rufopiceous) ..... *corrupta* n. sp.

13. Outer posterior angle of second discoidal cell slightly obtuse; second abdominal tergite only slightly longer than broad at apex; abdomen red, with petiole and 2 or 3 apical tergites black (*pinguis* group) ..... *pinguis* n. sp.
    Outer posterior angle of second discoidal cell distinctly acute, or if almost a right angle (as in *genuina* and *canadensis*) then abdomen uniformly, or almost uniformly, black; second tergite at least nearly twice (often almost three times) as long as broad at apex (*limenitidis* group) 14

14. Propodeum long and slender, its apical neck-like portion extending posteriorly to apical four-fifths of hind coxa; large (length 12–13 mm.), slender species, with abdomen strongly compressed and largely reddish ..... *lamina* (Vier.)
    Propodeum distinctly shorter and stouter, its apex less strongly neck-like and extending at most only to apical two-thirds of hind coxa; usually smaller species; abdomen sometimes only slightly compressed, varying in colour, sometimes largely or entirely black 15

15. Abdominal tergites usually entirely black, more rarely with a few of the tergites more or less suffused with dull reddish; abdomen rather stout, second tergite not quite twice as long as broad at apex 16
    Abdominal tergites usually conspicuously marked with reddish, often with the abdomen beyond the middle of the third tergite largely or entirely reddish, if tergites are almost entirely black (as sometimes in *forcipata*) then abdomen rather long and slender with second tergite almost three times as long as broad at apex 17

16. Hind tibia uniformly reddish ..... *genuina* (Nort.)
    Hind tibia largely blackish, the extreme base on outer side pale yellowish, with a more or less distinct pale stripe beyond ..... *canadensis* n. sp.

17. Male with each valve of aedeagus terminating in a slender, flattened process (Fig. 12); female with face almost (88.8–97.2%) as broad as combined lengths of face and clypeus ..... *limenitidis* (How.)
    Male with each valve of aedeagus terminating in a slender, cylindrical, spine-like process (Fig. 11); female with face distinctly (75.8–83.3%) narrower than combined lengths of face and clypeus 18

18. Abdomen beyond the third tergite conspicuously marked with black; post-petiole black, at most with only extreme apex paler; hind femur narrowly fuscous at apex; abdomen rather shallow in lateral aspect.....*forcipata* n. sp.
Abdomen uniformly reddish beyond third tergite; post-petiole sometimes largely or entirely reddish; hind femur usually without fuscous marking at apex; abdomen moderately deep in lateral aspect.....19

19. Median longitudinal sulcus indistinct on basal half of propodeum and very shallow beyond; middle coxa largely yellowish; post-petiole mostly black (more or less reddish on sides and at apex) [male unknown].....*vadosa* n. sp.
Median longitudinal sulcus well defined throughout length of propodeum; middle coxa varying from dark reddish to black; post-petiole reddish.....*affinis* n. sp.

DESCRIPTIONS OF SPECIES

(ambigua group)

This group is distinctive in several respects, notably in the form of areolet and the shape of the petiolar segment, and should be easily recognized by the combination of characters given in the key. It contains a single species which is evidently quite rare since it has never been recorded subsequent to Ashmead's original description which is based on a single male taken in Texas more than fifty years ago.

Casinaria ambigua (Tow.)

1890 *Nematopodius texanus* Ashmead, Proc. U.S. Nat. Mus., XII, 414.
1945 *Charops ambigua* Townes, Mem. Am. Ent. Soc., No. 11, Pt. II, 607. [new name].
1946 *Casinaria ambigua* (Townes), Townes, Bol. de Ent. Venezolana, V, No. 2, p. 62.

The structural details for this species given in the description below have been supplied through the kindness of Dr. H. K. Townes following his recent examination of the type specimen. The colour characteristics given are those contained in Ashmead's original description.

Male—Length 6 mm. Clypeus with margin truncate, narrowly reflexed; malar space about four-fifths as broad as basal width of mandible; occipital carina uniting with hypostomal carina at a point three-fifths the basal width of mandible distant from lower end of hypostomal carina; propodeum a little longer than high and not areolated; median longitudinal propodeal sulcus broad and weak; only the longitudinal propodeal carinae developed on the basal one-fifth and apical three-tenths of the length of the propodeum; areolet pentagonal, broadly sessile above; submedian cell slightly longer than the median; petiole unusually short and stout, its tergite with a weak dorsolateral flange at the extensor muscle attachment, giving a more prismatic appearance than in other species.

Black, opaque, shagreened, sparsely covered with glittering white hairs, especially on the face and along the sides of the body; antenna black; mandibles and palpi pale; legs brown, the posterior pair dark, the anterior pair more yellowish; the anterior and middle coxae (except anterior pair basally and a lateral spot on the middle pair), and second joint of all trochanters, yellow; apical margin of third and fourth segments of abdomen testaceous; wings hyaline, stigma and veins brown.

Female—Unknown.
Cocoon—Unknown.
Host—Unknown.
Type locality—Texas.
Type—Male, United States National Museum.

(scabriformis group)

This is a very distinct group, easily recognized by the broad, truncate clypeus, incomplete occipital carina, and the regular, complete, median longitudinal propodeal carinae. In no other group in the genus are these characters so combined. This group resembles the *ambigua* group in having the margin of the clypeus truncate. It is easily distinguished from the *ambigua* group by the presence of regular, complete, median longitudinal propodeal carinae. This latter character will also distinguish the *scabriformis* group from all other groups in the genus except the *geometrae* group which has somewhat similarly formed propodeal carinae and which in addition agrees with the present group and differs from all others in having the occipital carina incomplete. The form of the clypeus however is sufficient to distinguish at once between these two groups, the clypeus in the *geometrae* group being especially small and narrow, with the margin distinctly convex.

The members of this group are all very similar in structure. Moreover certain species vary considerably in colour. The most reliable characters for distinguishing them are given in the foregoing key.

Casinaria coloradensis n. sp.

Female—Length 6.0 mm. Head transverse, temple flat, only very slightly receding for a considerable distance behind eye, then sharply rounded to a plane perpendicular to longitudinal axis of body; occipital carina situated well beyond the sharply rounded edge of temple and almost parallel to it; antenna 27-segmented (in paratype); ocellocular space fully two-thirds diameter of lateral ocellus; malar space as in *eupitheciae;* mesoscutum with indistinct punctures obscured by fine granular sculpture; second abdominal tergite nearly twice as long as broad at apex.

Colour of body as in *eupitheciae*; front and middle coxae largely black, hind coxa entirely black; hind femur with a small blackish mark at apex; hind tibia dark reddish-brown beneath and at apex, otherwise mostly pale yellowish.

Male—Unknown.
Holotype—♀, Colorado, No. 2030 (C. F. Baker).
Paratype—♀, same data as holotype.
Holotype and paratype in United States National Museum.
Cocoon—Unknown.
Host—Unknown.

This species is most similar to *eupitheciae* from which it may be distinguished by the formation of the temple and the more extensive pale area on the hind tibia. In the same respects and also by the broader malar space and greater ocellocular distance it may be distinguished from *semiothisae*.

Casinaria semiothisae Wly.

Plate II, Figs. 3, 7.

1941 *Casinaria semiothisae* Walley, Can. Ent., LXXIII, 169.
1941 *Casinaria* sp. Brown, Dom. Can. Dept. Agr. Tech. Bull., 31, p. 10.
1945 *Charops eupitheciae* (Viereck), Townes, Mem. Am. Ent. Soc., No. 11, Pt. 2, 607. [in part].
1946 *Casinaria semiothisae* Walley, Townes, Bol. de Ent. Venezolana, V, No. 2, p. 62.

A detailed description of this species is given in Walley (1941).

This species is most liable to be confused with *eupitheciae* and *scabriformis* which it resembles in structure except as stated in the key. As noted below, *eupitheciae* and *scabriformis* may be distinguished from each other by the colour of the abdomen which in the former is invariably entirely black and in the latter always conspicuously more or less red. The abdominal colour in *semiothisae* varies from entirely black to a condition in which some of the tergites are conspicuously marked with red. Most examples of *semiothisae* have the abdomen at least partly reddish (frequently only the sides of the third tergite are reddish) by which means they may be distinguished from *eupitheciae*. Special care is required in distinguishing specimens of *semiothisae* in which the abdomen is entirely or almost entirely black, from *eupitheciae*, and for these careful consideration should be given to the structural differences noted in the key, and to the host data and the characters of the cocoon, as recorded below, when such information is available. On the other hand specimens of *semiothisae* in which the abdomen is extensively marked with reddish are liable to confusion with *scabriformis*, and here again structural characters must be relied on for distinguishing them, although it is also helpful to note that these two species appear to have rather distinct geographic distributions, *semiothisae* being a species confined to the Canadian and Transitional zones whereas *scabriformis* is limited to the Upper and Lower Austral zones.

Cocoon—Length 5.5 mm., diameter 3.0 mm. Resembles *eupitheciae* but a little larger and with a broader median pale annulus.

Hosts—Numerous specimens are at hand reared from the following hosts: *Semiothisa bisignata* Wlk., *S. granitata* Gn., *S. sexmaculata* Pack., *Caripeta divisata* Wlk.

Type locality—Mattawa, Ontario.

Type—Female, Canadian National Collection.

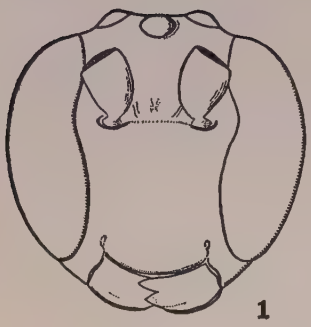
Distribution—Canada (many localities), transcontinental in the Transitional and Canadian zones. In United States known only from a single specimen from Casco, Me., but doubtlessly occurring in many other localities.

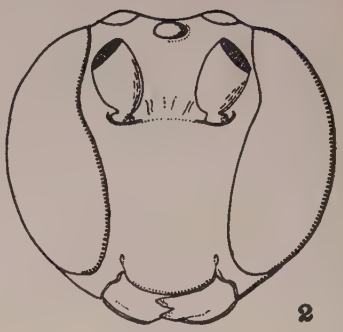
Casinaria eupitheciae Vier.

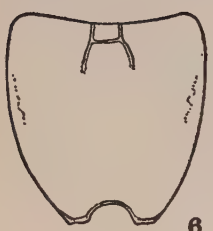
1912 *Casinaria eupitheciae* Viereck, Proc. U.S. Nat. Mus., XLIII, 586.
1917 *Casinaria (Casinaria) eupitheciae* Viereck, Viereck, Bull. Conn. Geol. Nat. Hist. Surv., No. 22, p. 270.
1925–1926 *Neonortonia eupitheciae* (Viereck), Viereck, Can. Ent., LVII, 179 [in key]; LVIII, 283.
1925–1926 *Campoplex (Hypothereutes) impetitus* Viereck, Can. Ent., LVII, 204 [in key]; LVIII, 223.
1940 *Casinaria eupitheciae* Viereck, Walley, Sci. Agr., XX, 651.
1941 *Casinaria eupitheciae* Viereck, Walley, Can. Ent., LXXIII, 169.
1941 *Casinaria* sp. Brown, Dom. Can. Dept. Agr. Tech. Bull. 31, p. 9.
1945 *Charops eupitheciae* (Viereck), Townes, Mem. Am. Ent. Soc. No. 11, Pt. II, 607. [in part].
1946 *Casinaria scabriformis* Viereck, Townes, Bol. de Ent. Venezolana, V, No. 2, p. 62. [in part].

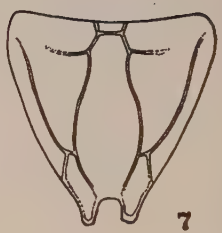
This species has been described in detail by Viereck (1912). Additional descriptive notes are given in Walley (1941).

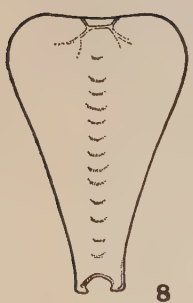
PLATE I. *Casinaria grandis* Wly. female.

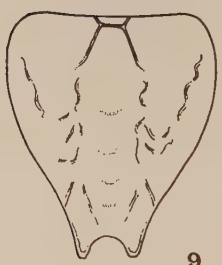












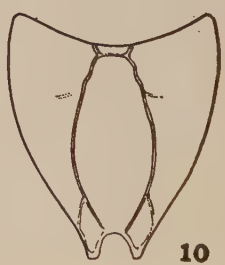


PLATE II. Structural details of *Casinaria* species.

1. *Casinaria limenitidis* (How.), head of female. 2. *C. affinis* n. sp., head of female. 3. *C. semiothisae* Wly., clypeus. 4. *C. geometrae geometrae* n. subsp., clypeus. 5. *C. infesta* (Cress.), clypeus. 6. *C. pinguis* n. sp., propodeum. 7. *C. semiothisae* Wly., propodeum. 8. *C. lamina* (Vier.), propodeum. 9. *C. infesta* (Cress.), propodeum. 10. *C. geometrae geometrae* n. subsp., propodeum. 11. *C. forcipata* n. sp., aedeagus. 12. *C. limenitidis* (How.), aedeagus.

In structure this species agrees with *scabriformis* Vier., from which it differs in colour notably in having all the abdominal tergites uniformly black. In *scabriformis* the abdomen is always extensively reddish, in the female usually entirely reddish beyond the middle of the third tergite, and similar in the male except that the apical tergites are sometimes more or less blackish in their uppermost portion. *Eupitheciae* eventually may prove to be a race of *scabriformis* rather than a distinct species as it is here regarded. Such a conclusion, should however be based on clearer evidence of intergradation than the present material affords.

Because of its close similarity in colour this species is liable to be confused with *semiothisae* (see discussion above) and *coloradensis* but may be distinguished from these species by the structural differences noted in the key.

Cocoon—Length 5.0 mm., diameter 2.5 mm.; feebly shining; brownish black, with a narrow, sordid greyish, median annulus. Compared with that of *semiothisae* the cocoon of this species is slightly smaller, with the pale median annulus a little narrower in proportion to the total length of the cocoon.

Hosts—*Eupithecia gibsonata* Tayl., *E. helveticaria* Bdv., *E. luteata* Pack., *E. miserulata* Grt., *E. palpata* Grt.

Type locality—East River, Connecticut.

Type—Female, United States National Museum.

Distribution—In Canada the distribution of this species is coextensive with that of *semiothisae*. In the United States specimens have been studied from the following regions: MAINE (Paris); MARYLAND (Takoma Pk.); NEW HAMPSHIRE (Pinkham Notch); NEW JERSEY (Moorestown); PENNSYLVANIA (Spring Br.); SOUTH CAROLINA (near Tigerville); VIRGINIA (Rosslyn); WASHINGTON (Elbe, Mt. Ranier); WEST VIRGINIA (Bolivar). A single specimen at hand from Banos, Ecuador (1900 metres), in the Townes collection also appears to pertain to this species.

Casinaria scabriformis Vier.

1912 *Casinaria scabriformis* Viereck, Proc. U.S. Nat. Mus., XLII, 635.
1917 *Casinaria (Casinaria) scabriformis* Viereck, Viereck, Bull. Conn. Geol. Nat. Hist. Surv., No. 22, p. 270.
1937 *Casinaria scabriformis* Viereck, Allen and Painter, J1. Agr. Res., LV, 225.
1945 *Charops eupitheciae* (Viereck), Townes, Mem. Am. Ent. Soc., No. 11, Pt. II, p. 607. [in part].
1946 *Casinaria scabriformis* Viereck, Townes, Bol. de Ent. Venezolana, V, No. 2, p. 62. [in part].

A detailed description of this species is given in Viereck (1912).

As here recognized *scabriformis* is a species which agrees in structure with *eupitheciae* but differs in colour in having the abdomen always considerably (often entirely) red beyond the middle of the third tergite. In general *scabriformis* has a more southern distribution than *eupitheciae*, although in the northern portion of its range it occurs at some of the same stations as *eupitheciae*. The absence of specimens from such regions showing intergradation in colour seems sufficient evidence to regard the species at present as distinct.

A variation of possible significance in the present species is found in two specimens from Oklahoma, in which the paler body markings are especially extensive and pronounced. These may represent a distinct race but too little material is yet available to reach a decision.

In general in this species the red abdominal markings are more extensive in the female, usually embracing the entire abdomen beyond the middle of the third tergite. In some males the crests of the apical tergites are suffused with blackish.

Cocoon—Unknown.

Host—Eupithecia miserulata Grt. (Viereck, 1917).

Type locality—Castle Rock, Delaware County, Pennsylvania.

Type—Female, United States National Museum.

Distribution—CONNECTICUT (East River); KANSAS (Lawrence, Manhattan, Wellington); MARYLAND (Takoma Pk.); MASSACHUSETTS (So. Hadley); NEW JERSEY (Moorestown); OKLAHOMA (Gore, Oklahoma City); SOUTH CAROLINA (Greenville).

In Canada known only from southernmost ONTARIO (Chatham, Leamington).

(*grandis* group)

This group differs from all others in the genus in having the scutellum strongly flattened and medianly impressed. It contains at present a single species which is further distinctive in its large size (length approx. 15 mm.), perpendicular vertex, coarsely sculptured thorax and propodeum, and in the absence of propodeal carinae.

Casinaria grandis new name

Plate I.

1890 *Campoplex texanus* Ashmead, Proc. U.S. Nat. Mus., XII, 427. [preoccupied in *Casinaria* by Ashmead, 1890].
1901 *Campoplex texanus* Ashmead, Dalla Torre, Cat. Hym., III, 153.
1912 *Fiebrigia texana* (Ashmead), Viereck, Proc. U.S. Nat. Mus., XLII, 638.
1940 *Campoplegidea texana* (Ashmead), Walley, Sci. Agr., XX, 706. [synonymy in error].
1945 *Charops texana* (Ashmead), Townes, Mem. Am. Ent. Soc., 11, Pt. II, 610.
1946 *Casinaria texana* (Ashmead), Townes, Bol. de Ent. Venezolana, V, No. 2, p. 62.

This is a very distinct species, easily recognized by the characters given in the key. In several respects it resembles *tenuiceps* of the *geometrae* group, both species having the head strongly lenticular, the scutellum broad, sternauli distinct, propodeum rather strongly produced posteriorly and the thorax and propodeum unusually coarsely sculptured. It differs from *tenuiceps* in its larger size, perpendicular vertex, strongly flattened and impressed scutellum, and especially in the absence of longitudinal propodeal carinae.

Female—Length 15.0 mm., sheath 1.3 mm. Head very strongly lenticular; temple flat and very strongly receding; vertex descending perpendicularly immediately behind lateral ocelli; eyes strongly emarginate within; face about as broad as combined lengths of face and clypeus; clypeus rather narrow, scarcely elevated, with free margin very broadly arcuate and narrowly impressed; malar space slightly greater than one-half

basal width of mandible; ocellocular space not quite one-half diameter of lateral ocellus; occipital carina rather strongly out-curved near base of mandible; hypostomal carina rather strongly elevated; antenna 45-segmented, median segments of flagellum distinctly broader than long; mandible short, broad, lower margin with a broad, forward-projecting lamina which terminates distally in a sharp curve, teeth about equal; outer surface of mandible with a low ridge extending from upper basal angle to base of notch between teeth; face and clypeus mostly roughened by irregular rugulae and numerous, shallow, poorly defined punctures; front concave, dullish, coarsely punctate; occiput polished.

Pronotum sharply declivous; epomia strong, forming a sort of scrobe for the reception of the head; mesoscutum opaque, densely punctate; notaulices indicated only by slight impression anteriorly; scutellum large, broad at apex, disk concave, opaque, densely rugose and punctate, with lateral carinae defined except at apex; mesopleura coarsely punctate and rugose; prepectoral carina complete; sternaulus marked by an irregular series of fovea-like depressions and irregular rugae; metapleura densely punctate and coarsely rugulose; propodeum broad, produced to apical fourth of hind coxa, spiracle twice as long as broad, median sulcus rather narrow and strongly defined; sculpture of propodeum consisting of very irregular coarse rugae, vestiture short, rather dense; legs long and slender, the femora especially so; areolet very small, petiole long, recurrent vein received close to second intercubitus; nervulus interstitial; nervellus very slightly reclivous.

Abdomen long and slender, strongly compressed beyond the bulbous post-petiole; second tergite with conspicuous gastrocoeli situated a little before middle, spiracles slightly before apical one-third; sheath very slender.

Head, thorax and propodeum black; scape and pedicel reddish-brown, flagellum brownish-black; mandibles brownish-stramineous; tegulae light yellowish-brown; front leg, except base of coxa and fifth tarsal which are brownish, pale yellow, the front femur with a reddish suffusion behind; middle coxa reddish-brown shading to black at base, middle trochanters and femur except at apex of latter reddish, remainder of middle leg yellowish with the fifth tarsal brownish; hind coxa black, hind femur, tibia and basitarsus reddish, remainder of hind tarsal segments brownish; first abdominal segment reddish; second abdominal tergite reddish with a blackish suffusion along the crest except at apex; remainder of abdominal tergites reddish, the seventh dusky on crest; sheath black; wings more or less tinged with brownish, the apices of front wings faintly banded.

Male—Very similar to the female in structure and colour; aedeagus blunt and only slightly decurved at apex.

Cocoon—Unknown.
Host—Unknown.
Type locality—Texas (Belfrage).
Type—Female, United States National Museum.

Distribution—Southernmost United States. Three specimens have been examined from the following localities: FLORIDA (Paradise Key); LOUISIANA (Crowley).

(geometrae group)

This group differs from all other groups in the genus, except the *scabriformis* group, in having the occipital carina incomplete and the propodeum with a pair of regular, complete, median longitudinal carinae. From the *scabriformis* group it is at once distinguished by the much narrower and distinctly convexly margined clypeus. Other distinctive features of the present group are as follows: hypostomal carina very strongly elevated, lamelliform in region near base of mandible; gena sometimes with a distinct impression; mandible short, broad, blackish; thorax and propodeum rather coarsely sculptured; sternaulus usually distinct and rather broad; scutellum broad, the disk with more or less distinct lateral carinae. In a few species (in the *infesta* and *limentidis* groups) which follow, the median longitudinal propodeal carinae are more or less distinct, but when so they are usually irregular, or incomplete, and thus differ from those found in the *geometrae* group. In other respects such species may be easily distinguished by the characters defining their respective groups.

Within the *geometrae* group three rather distinct species are recognized, one of which appears to be divisible into two principal geographic races.

Casinaria tenuiceps n. sp.

In its rather large size, very strongly receding temples and coarse body sculpture this species is somewhat suggestive of the *grandis* group. It differs notably however in the convex scutellum and the longitudinally carinate propodeum as well as by other characters mentioned below. From *cavigena*, of the present group, *tenuiceps* is easily separated by the much more strongly receding temples, the more conspicuously hairy scutellum and propodeum, the less pronounced genal excavation and the reddish femora and post-petiole. From *geometrae*, *tenuiceps* is distinguished by its larger size, coarser thoracic sculpture, more distinct genal excavation and the more conspicuous vestiture of the scutellum and propodeum.

Female—Length 10 mm. Head strongly lenticular, temple very broadly rounded and very strongly receding; face a little narrower than combined lengths of face and clypeus; clypeus narrow, margin convex; malar space two-fifths as broad as basal width of mandible; ocellocular space a little less than one-half diameter of lateral ocellus; gena impressed in region adjacent hypostomal carina, the latter very strongly elevated, with the free edge strongly reflexed in the direction away from the hypostome; antenna 39-segmented, shortest segments of flagellum a little broader than long; mandible as in *geometrae*; face and clypeus with numerous coarse irregular punctures separated in many places by very irregular short rugulae; frons somewhat similarly but more finely sculptured, and with a delicate median vertical carina.

Mesoscutum dull, with dense irregular shallow punctures; scutellum large, tumid, broad at apex, distinctly margined only at base, disk coarsely densely punctate, the punctures separated by irregular anastamosing rugulae, disk also with rather long dense erect brownish vestiture; mesopleura with coarse punctures confused by numerous coarse irregular rugae; sternaulus broad and distinct; metapleura with numerous poorly

defined punctures and coarse irregular rugae; propodeal sculpture and carinae as described for *geometrae*, apex of propodeum extending to apical third of dorsal surface of hind coxa; legs slender; areolet small, narrow, recurrent received close to second intercubitus.

Abdomen slender, moderately compressed; second tergite two and one-half times as long as broad at apex; sheath short, not extending beyond apex of abdomen.

Black except as follows: mandibular teeth castaneous; palpus yellowish-brown; tegula light brown; wing base yellowish; legs as in *geometrae* except that hind femur is reddish with apex narrowly fuscous; wing veins and stigma brownish-black, membrane distinctly tinged with brown; abdomen reddish except petiole, triangular area at base of second tergite, narrow band on apex of same and sheath, which are blackish.

Male—Structure and colour very similar to female, but with more conspicuous yellow markings on legs.

Holotype—♀, Atlanta, Ga., July 7, 1939 (P. W. Fattig).

Allotype—♂, Atlanta, Ga., July 9, 1939 (P. W. Fattig).

Paratypes—♀, same data as allotype; 2 ♂♂, Patuxent Ref[uge], Bowie, Md., Sept. 7, 10, 1945 (R. T. Mitchell).

Holotype and allotype in United States National Museum; paratypes in collection of R. T. Mitchell and in Canadian National Collection (No. 5698).

Cocoon—Unknown.

Host—Unknown.

Casinaria cavigena n. sp.

This species is remarkable for the large strongly impressed area on the gena near the base of the mandible, by which character it may be distinguished from all other species in the genus except *tenuiceps*, which has a somewhat similar but less pronounced impression. From *tenuiceps* it is easily distinguished by the much more strongly rounded and only slightly receding temple.

Female—Length 10 mm. Head transverse; temple only slightly receding for some distance behind eye, then rather strongly rounded to occiput; face a little narrower than combined lengths of face and clypeus; malar space two-thirds as broad as basal width of mandible; ocellocular space nearly one-half diameter of lateral ocellus; hypostomal carina in the form of a broad lamella, with the adjoining portion of gena strongly impressed to form a deep fovea which is visible when the head is viewed from a posterior-lateral aspect; antenna 40-segmented, shortest segments of flagellum as long as wide; form of mandible and sculpture of head as in *geometrae*.

Sculpture of thorax and propodeum resembling *geometrae* but a little coarser; sternaulus shallow but distinct; scutellum, large, broad, moderately convex, disk with fine lateral carinae; apex of propodeum extending a little beyond middle of dorsal surface of hind coxa; median longitudinal sulcus of propodeum well defined; median longitudinal propodeal carinae rather fine, lateral longitudinal carinae absent; legs and areolet as in *geometrae*.

Abdomen slender, rather weakly compressed; second tergite nearly two and one-half times as long as broad at apex; sheath not exceeding apex of abdomen.

Black except as follows: mandibular teeth castaneous; palpus and tegula brownish-black; wing base brown; femora almost black, but with a castaneous tinge, apex of front femur narrowly sordid yellowish; front and middle tarsi brownish with outer surface of basal segment pale yellowish except at apex; hind tibia and tarsus blackish, with bases with a narrow pale annulus; calcaria brownish, the posterior pair darker than the others; wing veins and stigma dark brown, membrane slightly dusky; abdomen with a preapical reddish band on second tergite, all of the third tergite except a small fuscous triangular area at base, and the following tergites entirely, reddish.

Male—Unknown.

Holotype—♀, Monterey Co. Calif., June 1, 1904 (Coleman).

Holotype in United States National Museum.

The holotype bears a second label "*Pinus radiata*" and the cocoon which is fastened by one side to a leaflet is borne on the same pin.

Cocoon—Length 8.5 mm., diameter 4 mm., greyish-white, marked near each end with an almost complete but irregular annulus formed by the fusion of blackish spots, the ends speckled with similar but smaller blackish dots.

Host—Unknown.

Casinaria geometrae n. sp.

Differs from *tenuiceps* and *cavigena* as stated in the key and in discussions under those species. *Geometrae* is a fairly common, widely distributed and rather variable species which appears to be divisible into two principal geographic races which are differentiated and discussed separately below.

Casinaria geometrae geometrae n. subsp.

Plate II, Figs. 4, 10.

Females of this subspecies may be distinguished from those of the subspecies *occidentalis* by their more strongly receding temples, uniformly reddish apical abdominal segments, and generally by the paler colour of the tegulae. The males lack good distinguishing characters, but usually the males of the present subspecies have the tegulae pale yellow whereas in *occidentalis* the tegulae are dark brown or black. Other differences which may be of value in separating the present race from *occidentalis* are its slightly smaller size, generally more coarsely sculptured propodeum, and the tendency for the leg colour to be more or less reddish.

Female—Length 7.5 mm. Head lenticular, temple broadly rounded and rather strongly receding; face slightly narrower than combined lengths of face and clypeus; malar space one-half as broad as basal width of mandible; ocellocular space one-half diameter of lateral ocellus; hypostomal carina rather strongly elevated; antenna 32-segmented, shortest segments of flagellum a little longer than broad; mandible short, almost as broad at base as long, strongly narrowed distally, lower margin with a broad forward-projecting lamina; face and clypeus finely granularly roughened, with very dense, irregular, poorly defined punctures; frons a little less coarsely sculptured.

Mesoscutum dull, finely granularly roughened and with dense, coarse, poorly defined punctures; scutellum large, broad at apex, weakly convex, with fine lateral carina, disk with numerous coarse irregular punctures confused by irregular rugulae; mesopleura with numerous shallow, irregular punctures on a finely granular surface; sternaulus broad, distinct; metapleura coarsely densely punctate and somewhat rugulose; propodeum moderately slender, the apex produced a little beyond middle of dorsal surface of hind coxa, median longitudinal sulcus distinct; longitudinal propodeal carinae distinct, the median pair rather regular and complete, the lateral pair often more irregular and incomplete posteriorly; propodeal sculpture consisting of numerous, coarse, very irregular rugulae; legs slender; areolet small, narrow, recurrent received close to second intercubitus.

Abdomen slender, moderately compressed; second tergite about twice as long as broad at apex; sheath not extending beyond apex of abdomen.

Black except as follows: mandibular teeth castaneous; palpi yellowish; tegula and wing base yellowish tinged with brown; front and middle trochanters brownish; front leg beyond trochanter reddish, with outer surface of tibia and tarsus yellowish; middle leg similar, but with femur suffused with brownish toward the base; hind leg brownish-black with tibia narrowly annulate with yellowish at base; wing veins and stigma dark brown, membrane slightly dusky; subapical band on second tergite, third tergite except at base, and all the tergites entirely beyond, reddish.

Male—Resembling the female in structure and colour. Differs from the female in having the apical two or three tergites more or less black.

Holotype—♀, Smiths Falls, Ont., Forest Insect Survey, 1939 (emerged in incubator Jan. 30, 1940), Host, *Protoboarmia porcelaria* Gn.

Allotype—♂, same data as holotype (emerged in incubator Jan. 23, 1940).

Paratypes—11 ♂♂, 17 ♀♀ from following localities (emergence data omitted for specimens reared in laboratory). MD.: Plummers Island, May 8, 1910 (E. A. Schwarz). N.C.: Ashe Co., July 5, 1940 (B. C. Barnes). N.J.: Moorestown, June 25, 1939 (H. and M. Townes), Tabernacle, June 11, 1939 (H. K. Townes). N.S.: Baddeck, June 26, 1936 (J. McDunnough). N.Y.: Babylon, Long Isl., June 26, July 7, 8, 1936 (Blanton and Borders), Millwood, June 26, 1936. (H. K. Townes). ONT.: Merivale, May 23, 1932 (G. S. Walley), Pakesly, Petawawa Reserve, St. Williams. QUE.: Berthierville, Ft. Coulonge, Lac Cayamant, Lanoraie, Old Chelsea, St. Michel de Wentworth, St. Norbert, Shawville, Winslow Canton, Woodbridge Canton. W. VA.: Ft. Pendltn., Aug. 7.

Holotype, allotype and paratypes No. 5699 in Canadian National Collection. Paratypes in United States National Museum and collection of H. K. Townes.

Cocoon—Length 5–6.5 mm., diameter 2–2.5 mm. Sordid greyish-white, marked near each end with an annulus of irregular brownish or blackish spots, also with a few similar spots on ends.

Hosts—Caripeta angustiorata Wlk., *C. divisata* Wlk., *Eufidonia notataria* Wlk., *Paraphia piniata* Pack., *Protoboarmia porcelaria* Gn., *Semiothisa granitata* Gn.

Remarks—This subspecies varies considerably in size, sculpture and colour. Specimens at hand range in length from 6 to 8.5 mm. A few examples have the thorax and propodeum with the sculpture less coarse than described above, and occasionally the sternaulus is only slightly impressed. In some males the speculum is polished over a small area, while in most males the thoracic and propodeal sculpture is somewhat stronger than in the female. The tegulae are usually pale yellow but in a few examples they are pale brownish. The coxae vary from pure black to dark brown, and the hind femora from reddish-brown to black. Specimens with reddish-brown hind femora frequently also have the post-petiole more or less reddish-brown.

Distribution—This subspecies inhabits temperate eastern North America and may extend as far west as Washington and British Columbia. The basis for this latter statement rests for the present on two specimens (Easton, Wash. and Edgewood, B.C.) which appear to pertain to this race rather than to the western subspecies *occidentalis* which also occurs in British Columbia.

Casinaria geometrae occidentalis n. subsp.

The principal features separating this geographic race from the typical subspecies are given in the key and in the discussions above. The following description is comparative with that of the typical form and includes only those characters showing differences which seem worthy of note.

Female—Length 9.0 mm. Head less strongly lenticular; temple only slightly receding for some distance posterior to eye, then rather strongly rounded to occiput; antenna 35-segmented; sternaulus, rather indistinct. Tegula and wing base dark brown; leg colour mostly black, the four anterior legs black or dark brownish black almost to apex of femur; front tibia reddish-brown beneath, with a pale stripe on outer surface; front tarsi brownish, the basal segment somewhat pale; middle tibia brown with an outer pale stripe; hind legs black, the tibia with a small pale spot above at extreme base; abdomen beyond the fifth tergite black.

Male—Structure and colour very similar to female.

Holotype—♀, Carmel Calif., July 31, 1933 (L. S. Slevin).

Allotype—♂, San Francisco, Calif., Nov. 22, 1925 (H. H. Keifer).

Paratypes—2 ♂♂, 20 ♀♀, from following localities (emergence data omitted for specimens reared in laboratory). B.C.: ♀, Box Lake (near Nakusp) Sept. 9, 1943 (host, *Semiothisa granitata*). ♀, Kuskanook Creek (near Nakusp) Aug. 30, 1943. ♀, 3 miles s.e. of Clinton (host, *Semiothisa granitata*). ♀, Hazelton, Sept 14, 1938 (J. Willan). ♂, Trout creek, Summerland, Aug. 1, 1943 (host, *Semiothisa* sp.). ♂, Upper Arrow Forest, Lardo dist. (host, *Semiothisa granitata*). CALIF.: 3 ♀♀, Berkeley, Mar. 25, May 10, Dec. 9, 1944 (R. M. and G. E. Bohart). 8 ♀♀, Carmel, Mar. 10, 1934, May 24 and June 7, 1931, July 14, 1935, Sept. 3, 1933, Sept. 20, 1925, Oct. 21, 1921 (L. S. Slevin). 3 ♀♀, San Francisco, Mar. 8, 1926 (H. H. Keifer) bred from *R. californicus*, Mar. 27, 1913 and Sept. 1, 1918 (C. L. Fox). ♀, San Francisco Co., Nov., (F. E. Blaisdell). ♀ (locality not known), ex Koebele Coll., also bearing label with data "*Tetracis aegrotata* on rose, Mar. 10.08".

Holotype, allotype and paratypes in California Academy of Sciences. Paratypes in Canadian National Collection (No. 5700) and in United States National Museum.

Cocoon—Similar to that of the typical race.

Hosts—*Sabulodes caberata* Gn. (= *Tetracis aegrotata*), *Semiothisa granitata* Gn., *Semiothisa* sp.

Remarks—The Californian specimens at hand are all very similar in size, structure and colour. Among them the leg colour varies slightly, a few examples lacking the pale outer stripe on the front and middle tibia, having merely a spot at the base instead; in others the preapical reddish band on the second tergite is almost lacking, while in all, the wings are rather distinctly suffused with brownish. Specimens from British Columbia vary in size (the two males at hand are rather small) and have clear wings. Also usually they have the fifth as well as the following tergites black, and the reddish band on the second tergite is much reduced.

A single female from Colorado (C. F. Baker Coll., No. 1341) possibly pertains to this subspecies but it is remarkable in having the propodeum with unusually reduced sculpture, the front femur largely reddish and the tegula and wing base pale yellowish.

Distribution—This species is known to occur in the coastal region of central California and in southern British Columbia. As noted above, specimens from the latter region differ somewhat from those occurring in California. These differences may be the expression of slight geographical variation or possibly represent a certain amount of intergradation with the typical subspecies.

(infesta group)

This group may be readily recognized by the combination of characteristics noted in the key. It possesses a number of unusual features among which may be mentioned the very short malar space, elongate mandible, rather broad clypeus and the unusually elongate sheath in the female. In some respects it is reminiscent of the genus *Idechthis*. Two very similar species are found in the territory included in this study.

Casinaria infesta (Cress.)

Plate II, Figs. 5, 9.

1872 *Limneria infesta* Cresson, Trans. Am. Ent. Soc., IV, 172.
1890?*Limneria sessilis* Ashmead, Proc. U.S. Nat. Mus., XII, 433. [preoccupied].
1890?*Limneria erythrogaster* Ashmead, Proc. U.S. Nat. Mus., XII, 434.
1901 *Limnerium ashmeadii* Dalla Torre, Cat. Hym., III, 90. [new name for *Limneria sessilis* Ashm.].
1901 *Limnerium erythrogastrum* Ashmead, Dalla Torre, Cat. Hym., III, 95.
1901 *Limnerium infestum* Cresson, Dalla Torre, Cat. Hym., III, 98.
1906 *Angitia autumnalis* Viereck, Trans. Am. Ent. Soc., XXXII, 181.
1911 *Anempheres diaphaniae* Viereck, Proc. U.S. Nat. Mus., XL, 188.
1912 *Amorphota diaphaniae* (Viereck), Viereck, Proc. U.S. Nat. Mus., XLII, 631.
1914 *Casinaria infesta* (Cresson), Gahan, Proc. U.S. Nat. Mus., XLVIII, 155.
1922 *Amorphota infesta* (Cresson), Chittenden, Can. Ent., LIV, 174.
1925 *Casinaria infesta* (Cresson), Swezey, Proc. Haw. Ent. Soc., VI, 296.
1925–1926 *Neonortonia autumnalis* (Viereck), Viereck, Can. Ent., LVII, 179 [in key]; LVIII, 383.
1926 *Amorphota infesta* (Cresson), Viereck, Trans. Roy. Soc. Can., XX, sect. 5, 183.
1926 *Amorphota diaphaniae* (Viereck), Viereck, Trans. Roy. Soc. Can., XX, sect. 5, 183.

1926 *Casinaria* sp. probably *infesta* (Cresson), Hamelin, Pan. Pac. Ent., II, 100.
1926 *Casinaria infesta* (Cresson), Swezey, Jl. Ec. Ent., XIX, 720.
1928 *Casinaria infesta* (Cresson), Poos, Proc. Ent. Soc. Wash., XXX, 146.
1935 *Casinaria infesta* (Cresson), Swezey, Proc. Haw. Ent. Soc., IX, 94.
1935 *Casinaria infesta* (Cresson), Ball, Reeves, Boyden and Stone, U.S. Dept. Agr. Tech. bull. 463, 40.
1937 *Casinaria infesta* (Cresson), Summerland, Trans. Kan. Acad. Sci., XL, 164.
1938 *Casinaria infesta* (Cresson), Brimley, Insects of North Carolina, p. 415.
1938 *Amorphota diaphaniae* (Viereck), Brimley, Insects of North Carolina, p. 415.
1945 *Charops infesta* (Cresson), Townes, Mem. Am. Ent. Soc., No. 11, pt. II, 609.
1946 *Casinaria infesta* (Cresson), Townes, Bol. de Ent. Venezolana, V, No. 2, p. 62.

This species is very similar to *corrupta* from which it is known to differ only in the colour of the legs as stated in the key and in the description of *corrupta* given below.

Female—Length 6.5–10 mm. Head moderately thickened; temples broadly rounded and moderately receding; clypeus almost as broad as face, the latter rather shining and coarsely rugose-punctate; malar space approximately one-fourth as broad as basal width of mandible; ocellocular space about two-thirds diameter of lateral ocellus; occipital carina uniting with hypostomal carina a short distance from base of mandible; mandible distinctly longer than its greatest width, lamina of lower margin only moderately developed and gradually narrowed distally.

Thorax rather coarsely sculptured; mesoscutum dullish; mesopleura more shining and usually with a large polished speculum, the lower portion of mesopleura coarsely, often confluently, punctate; sternaulus absent or indistinct; scutellum small, convex, distinctly narrowed apically; propodeum slender, the narrow apical portion extending a little beyond middle of dorsal surface of hind coxa; median longitudinal sulcus of propodeum distinct; sculpture of propodeum consisting of dense, irregular punctures confused with short, very irregular rugulae, which latter are especially developed on the convexly rounded surface along either side the median longitudinal sulcus, in some examples the larger rugulae appearing to represent portions of the transverse and longitudinal carina which latter however are never complete or well defined.

Post-petiole rather narrow, convex; second abdominal segment distinctly compressed, the tergite at least twice as long as broad at apex; gastrocoeli situated at basal third; abdomen beyond second segment strongly compressed; sheath extending distinctly beyond apex of abdomen.

Head, thorax and propodeum black; scape yellow, marked with blackish on upper surface; pedicel blackish, usually more or less yellowish beneath; mandibles, palpi, tegulae and wing bases yellowish; front and middle coxae reddish to blackish, with paler apices; hind coxae black; trochanters yellowish; front femora and tibiae pale reddish shading to yellowish on anterior surfaces; front tarsi yellowish, tinged with reddish on apical segments; middle femora reddish, with yellowish apices; middle tibia and tarsi as in anterior legs; hind femora and tibia reddish, the latter with a narrow yellowish basal annulus and the upper surface toward apex more or less dusky; hind tarsi brownish-black; abdomen largely reddish; petiole black; second tergite blackish with a varying amount of reddish along the sides and before apex; third tergite blackish at base; sheath blackish.

Male—Temples a little less strongly receding than in female; propodeal rugulae usually stronger than in female; otherwise structure and colour as described for female.

Remarks—The species exhibits some variation in the sculpture of the mesopleura and propodeum. In occasional examples the mesopleural punctures are well separated with the intervals between punctures finely granular, and in some females the propodeal rugulae are almost lacking, the sculpture consisting almost entirely of very dense, more or less confluent, irregular, shallow punctures.

Cocoon—Length 7 mm., diameter 2.5 mm., uniformly brown except for a very faint trace of a narrow median slightly paler annulus.

Hosts—The following list includes records for North America, taken from the literature cited above, together with those from specimens at hand. In addition Swezey (1926) has reported the species as established in Hawaii where it has been reared as a parasite of *Hymenia fascialis* Cram. and eight other pyralids. North American host records are as follows: *Ancylis comptana* Froel., *Autographa falcifera* Kby., *Diaphania hyalinata L.*, *Hymenia fascialis* Cram., *H. perspectalis* Hbn., *Loxostege obliteralis* Wlk., *Loxostege* sp., *Mimorista flavidissimalis* Grote, *Mimorista* sp., *Pachyzancla bipunctalis* Fabr., *Phlyctaenia rubigalis* Guenee, weed infesting pyralids.

In Florida, Ball (1935) states that the species is a minor factor in the control of *Phlyctaenia rubigalis* Guenee and *Autographa falcifera* Kby. Hamelin (1926) notes that it is the foremost parasite of *Mimorista flavidissimalis* Grote in the Brownsville, Texas region.

Type locality—Bosque County, Texas.

Type—Female, United States National Museum.

Distribution—This species inhabits the Upper and Lower Austral zones in eastern North America. The northernmost records at hand are from southern Michigan, Ohio and District of Columbia. On the west it has been reported from Iowa, Kansas and Texas, with a single record (Chittenden, 1922) from Smeltzer, California. It is particularly abundant in the states along the Atlantic seaboard and those bordering the Gulf of Mexico. Specimens are also at hand from Mexico and the Hawaiian Islands.

Casinaria corrupta n. sp.

Female—Length 10 mm. Agreeing with the foregoing description of *infesta* with respect to structure and colour of body. Differs from *infesta* in colour of legs as follows: front coxa black except for a small pale yellow spot at apex; front trochanter brownish-black on upper surface, pale yellow beneath; front leg beyond trochanter pale yellowish, with apical segment of tarsus light brownish; middle leg black almost to apex of femur, pale yellowish beyond; hind leg almost uniformly black except for a very narrow pale yellowish annulus at base of tibia and another at base of first tarsal segment.

Male—Very similar to female in structure and colour.

Holotype— ♀, Brownsville, Tex., Jan. 15, 1942, No. 49876, ex *Diaphania* sp. (Lot No. 42-855).

Allotype—♂, same data as holotype.

Paratypes—2 ♂♂, same data as holotype; ♀, Mercedes, Tex., Mar., (T. D. Urbahns).

Holotype, allotype and paratypes in United States National Museum; paratype (No. 5701) in Canadian National Collection.

Cocoon—Unknown.

Host—Diaphania sp.

Remarks—The specimen from Mercedes, Tex. differs from the others at hand in having the hind leg beyond the coxa very dark reddish-brown instead of black.

Distribution—Texas.

(pinguis group)

The most distinctive features of this group are the slightly obtuse outer posterior angle of the second discoidal cell, the unusually small, short radial cell, the broad, only slightly narrowed propodeum and the stout, fusiform abdomen in which the second tergite is only slightly longer than broad at its apex.

Casinaria pinguis n. sp.

Plate II, Fig. 6

Female—Length 7.5 mm. Head rather thick, temples only moderately receding; face as broad as combined lengths of face and clypeus; clypeus narrow, convex; ocellocular space slightly greater than diameter of lateral ocellus; antenna 37-segmented, the shortest segments of flagellum a little longer than wide; mandible slightly longer than its greatest width; occipital carina weak in its lower extremity; face and clypeus finely evenly granular and very indistinctly punctured.

Thorax with fine granular microsculpture and numerous fairly distinct shallow punctures, the latter densest on the mesoscutum, lower half of mesopleura and the metapleura; sternaulus represented only by a short, broad impression near prepectoral carina; scutellum small, disk convex, its sides immargined except at base; propodeum unusually broad, sides subparallel in basal two-thirds, narrowing slightly beyond; propodeum less strongly produced than is customary for the genus, the apex extending only slightly beyond the basal third of dorsal surface of hind coxa; dorsal surface of propodeum convex at base and broadly flattened or very feebly concave beyond, otherwise without evidence of a longitudinal sulcus; dorsal and lateral surfaces of propodeum meeting in an obtusely rounded angle which is surmounted by a more or less distinct irregular carina; median longitudinal propodeal carinae represented only by a pair of fine, short slightly diverging carinae which do not extend beyond the basal third of propodeum and which are sometimes joined at the base by a delicate transverse carina; sculpture of propodeum consisting of a combination of numerous shallow irregular punctures and fine reticular rugulae; radial cell small, short, approximately three-fourths as long as discocubital cell; outer posterior angle of second discoidal cell slightly obtuse; nervulus interstitial.

Abdomen compact, only slightly compressed; petiolar segment short and stout, with post-petiole unusually large and broad; second abdominal tergite slightly longer than broad at apex: (31 : 27), gastrocoeli close to base; sheath not surpassing apex of abdomen.

Head, thorax and propodeum black; palpi brown; mandible black, teeth castaneous; tegula brownish-black; legs red except as follows: coxae and trochanters (except apices of latter) black; distal two or three segments of front tarsus brownish; middle tarsus mostly pale brownish; hind tibia narrowly ringed with blackish at base and with a broader infuscate region on upper surface at apex; hind tarsus blackish, the first segment with extreme base pale; wings tinged with pale brownish; abdomen red, with the petiole (and sometimes the basal portion of post-petiole) black, the base of the second tergite narrowly blackish and the sixth and following tergites black above, shading to castaneous or dull reddish on the sides; sheath black.

Male—Very similar to the female in structure and colour. Claspers of male unusually narrow and somewhat attenuate at apices; aedeagus blunt, broadly decurved at apex.

Holotype—♀, Regina, Sask., Aug. 5, 1944 (J. G. Rempel).

Allotype—♂, Uren, Sask., July 11, 1944 (J. G. Rempel).

Paratypes—♂, same data as allotype; ♀, Regina, Sask., Aug. 8, 1944 (J. G. Rempel); ♂, Muskoka [District], Ont., Aug. 1925 (H. S. Parish).

Holotype, allotype and paratype in Townes collection. Paratypes (No. 5702) in Canadian National Collection.

Cocoon—Unknown.

Host—Unknown.

Distribution—Ontario, Saskatchewan.

(limenitidis group)

The species comprising this group display considerable diversity in structure making the group less compact than those preceding. The most striking characteristic of the group is found in the male genitalia in which each valve of the aedeagus is modified to terminate distally in a slender curved spine or a narrow flattened acuminate process. In all the males examined* in other groups the apices of the valves of the aedeagus are blunt and rounded. In the female the *limenitidis* group is less precisely defined but may be recognized by a combination of several characters (also shared by the male) which may be best appreciated by reference to the foregoing key. None of these latter characteristics is unique for the present group; indeed one or more are usually present in other groups but in no other single group are they all so combined. Species of this group may be conveniently divided into three sub-groups. The first of these contains a single species (*lamina*) best defined by its large size (length 12–13 mm.), very slender strongly produced propodeum and the very strongly compressed abdomen. The second sub-group contains two very similar species (*genuina* and *canadensis*) characterized by a compact body form, rather short propodeum

* The male genitalia of all the species contained in this study have been examined except for the following: *ambigua*, *coloradensis*, *cavigena*, *corrupta* and *vadosa*, of which species all except *ambigua* are as yet known only from the female.

and moderately compressed, black abdomen. The remaining species (*limenitidis*, *forcipata*, *affinis* and *vadosa*) form a sub-group in which the body form is slender as compared with *genuina* and *canadensis*, while the abdomen is usually more elongate and compressed and always with more or less conspicuous reddish markings.

Casinaria lamina (Vier.)

Plate II, Fig. 8.

1921 *Zastenomorpha lamina* Viereck, Psyche, XXVIII, 81.
1928 *Zastenomorpha lamina* Viereck, Cushman, Mem. Cornell Univ. Agr. Exp. Sta.,No.101 p. 955.
1945 *Charops lamina* (Viereck), Townes, Mem. Am. Ent. Soc., No. 11, Pt. II, p. 610.
1946 *Casinaria lamina* (Viereck), Townes, Bol. de Ent. Venezolana, V, No. 2, p. 62.

This species differs from all other species included in this synopsis in its more slender, elongate propodeum. In this respect it recalls (*Zastenogastra*) *Casinaria graciliventris* (Vier.), a South American species, with which it also agrees in its large size, strongly compressed abdomen, and the unusually long, slender second abdominal tergite. It differs from *graciliventris* in having the propodeum with a well developed median longitudinal sulcus.

The principal characteristics of this species are given in Viereck's original description, which may be amplified somewhat as follows: temples very broadly rounded, strongly receding; clypeus rather narrow, with free margin very broadly convexly arcuate; malar space slightly more than one-third basal width of mandible; ocellocular space a little less than diameter of lateral ocellus; radial cell long; areolet small (incomplete in one specimen); sheath small, slender and slightly upcurved. Male with valves of aedeagus terminating in spine-like processes.

Cocoon—Length 9.0 mm., diameter 4.5 mm. Dull, greyish-white.

Hosts—*Epargyreus tityrus* Fabr.; unidentified skipper feeding on *Lespedeza* sp.

Type locality—Great Falls, Virginia.

Type—Female, Museum of Comparative Zoology.

Distribution—IOWA (Emmet Co.); MARYLAND (Cabin John, Glen Echo, Patuxent Ref., Bowie); MASSACHUSETTS (Lincoln); NEW YORK (Ithaca); OHIO (Hocking Co.); ONTARIO (Gananoque Lake, Normandale); PENNSYLVANIA (Pt. Pleasant); VIRGINIA (Rosslyn, Great Falls).

Casinaria genuina (Nort.)

1863 *Campoplex genuinus* Norton, Proc. Ent. Soc. Phila., I, 367.
1864 *Mesoleptus major* Cresson, Proc. Ent. Soc. Phila., III, 257.
1875 *Mesoleptus major* Cresson, Provancher, Nat. Can., VII, 270, 271.
1879 *Campoplex niger* Provancher, Nat. Can., XI, 148.
1879 *Limneria genuina* (Say) [Norton intended], Provancher, Nat. Can., XI, 177.
1882 *Limneria genuina* var. *niger* (Provancher), Provancher, Nat. Can., XIII, 364.
1883 *Campoplex niger* Provancher, Provancher, Pet. Faune Ent. du Can., II, 362.
1883 *Limneria genuina* (Say) [Norton intended], Provancher, Pet. Faune Ent. du Can., II, 369.
1883 *Limneria genuina* var. *niger* (Provancher), Provancher, Pet. Faune Ent. du Can., II, 786.
1884 *Limneria genuina* (Norton), Taylor, Can. Ent., XVI, 91.
1886 *Limneria genuina* (Norton), Provancher, Addit. Faune Ent. Can. Hymen., p. 85.

1887 *Limneria major* (Cresson), Cresson, Synopsis Hymen, N. Am., p. 203.
1890 *Casinaria major* (Cresson), Riley and Howard, Insect Life, III, 157.
1894 *Exetastes? niger* (Provancher), Davis, Proc. Acad. Nat. Sci. Phila., XXI, 188.
1897 *Limneria major* (Cresson), Harrington, Can. Ent., XXIX, 45.
1901 *Exetastes provancheri* Dalla Torre, Cat. Hymen., III, 73 [new name for *Campoplex niger* Provancher].
1901 *Limneria majus* (Cresson), Dalla Torre, Cat. Hymen., III, 98.
1910 *Campoplex genuinus* Norton, Viereck, Ann. Rept. N.J. St. Mus. for 1909, p. 619.
1911 *Anephares rufipes* Hancock, Nature Sketches in Temperate America, p. 177.
1912 *Casinaria (Neonortonia) genuina* (Norton), Viereck, Proc. U.S. Nat. Mus., XLIII, 592.
1917 *Casinaria (Neonortonia) genuina* (Norton), Viereck, Bull. Conn. Geol. Nat. Hist. Surv., No. 22, p. 271.
1919 *Exetastes suaveolens* Walsh, Gahan, Proc. U.S. Nat. Mus., LV, 114 [in part].
1925 *Neonortonia genuina* (Norton), Viereck, 55 Ann. Rept. Ent. Soc. Ont., p. 102.
1925 *Neonortonia genuina* (Norton), Viereck, Can. Ent., LVII, 179.
1930 *Casinaria genuina* (Norton), Stewart, Jl. N.Y. Ent. Soc., XXXVIII, 46.
1931 *Casinaria genuina* (Norton), Cole, Ent. News, XLII, 9.
1934 *Neonortonia major* (Norton), Schaffner and Griswold, Misc. Pub. U.S. Dept. Agric., 188, p. 149.
1937 *Casinaria genuina* (Norton), Cushman, Proc. U.S. Nat. Mus., LXXXIV, 245.
1945 *Charops genuina* (Norton), Townes, Mem. Am. Ent. Soc., No. 11, Pt. II, 608.
1946 *Casinaria genuina* (Norton), Townes, Bol. de Ent. Venezolana, V, No. 2, p. 62.

Very similar to *canadensis* in structure and colour, but differing from that species in the slightly thicker head, more strongly rounded temple, slightly broader malar space, blackish mandible, tegula and trochanters, and especially in having the hind tibia uniformly reddish throughout. Except in the foregoing respects the description of *canadensis* given below applies with equal propriety to the present species.

Cocoon—Variable in size, the smallest specimen examined with measurements, length 6.5 mm., diameter 3.5 mm. and the largest, length 9.0 mm., diameter 5.0 mm.; sordid white, with a broad, irregular blackish annulus near either end and a few blackish dots at apex.

Hosts—The records at present available indicate that the commonest hosts are species of the family Arctiidae. One specimen at hand was reared from the larva of *Apantesis virgo* Linn., while two others were reared from unidentified arctiid larvae of the "woolly bear" type. Records from the literature are as follows: *Hyphantria cunea* Dru., *Estigmene acrea* Dru., unidentified arctiid, unidentified nymphalid (Schaffner and Griswold, 1934), woolly bear (Hancock, 1911), grape-vine larva (Riley and Howard, 1890), *Acronicta oblinita* Abb. and Sm. (Cole, 1931), *Neodiprion abietis* Harr. (Viereck, 1910).

Type locality—Farmington, Connecticut.

Type—Cotypes in Peabody Museum, Yale University.

Distribution—ALBERTA (Banff); BRITISH COLUMBIA (Aspen Grove, Vancouver Isl., Victoria); COLORADO (locality unknown); CONNECTICUT (Farmington); DELAWARE (locality unknown); ILLINOIS (?Chicago); MAINE (Gorham, Ogonquit); MICHIGAN (Frankfort); NEW BRUNSWICK (Fredericton); NEW HAMPSHIRE (Swainboro); NEW MEXICO (Santa Fe); NEW YORK (Buffalo, Gowanda, Hamburg); NOVA SCOTIA (Annapolis); OHIO (Put-in-Bay); ONTARIO (Beamsville, Jordan, Spencerville); QUEBEC (Abbottsford, Clarenceville); SASKATCHEWAN (Great Sand Hills west of Swift Current); TEXAS (locality unknown); VERMONT (Middlesex); WASHINGTON (Easton, Pullman).

Casinaria canadensis n. sp.

Very similar to *genuina* but easily distinguished from that species by the banded hind tibia and by other characters as noted in the discussion under *genuina*.

Female—Length 9.0 mm., antenna 5.5 mm. Head lenticular, temple very broadly rounded, strongly receding; face slightly narrower than combined lengths of face and clypeus; clypeus rather narrow, slightly convex; malar space one-half as broad as basal width of mandible; ocellocular space slightly less than diameter of a lateral ocellus; occipital and hypostomal carinae uniting at base of mandible; antenna 37-segmented, shortest segments of flagellum a little longer than broad; mandible short, broad, with a broad lamina on lower margin; head mat, face and frons with fine, dense, granular-punctate sculpture.

Pronotum rugulose in lower portion, densely punctate above; mesoscutum and scutellum subopaque, finely granular and evenly, densely punctate; mesopleura more shining, on upper half shagreened or finely reticulate, sparsely punctate and with several rugulae, below densely punctate on a granular surface; sternaulus absent; metapleura granular and densely punctate, somewhat rugulose below; propodeum moderately broad, evenly narrowing posteriorly, with apex extending to middle of dorsal surface of hind coxa; propodeal sulcus broad and distinct but not deeply impressed; pleural carina distinct, otherwise propodeum with but a single short transverse carina at extreme base; propodeum with dense, shallow punctures and numerous short reticulate rugulae, the latter especially best developed in dorsal and posterior regions; legs moderately slender; radial cell rather short; areolet petiolate, recurrent received a little beyond middle; nervulus interstitial; nervellus strongly reclivous.

Abdomen moderately lengthened, fusiform, lightly compressed; second tergite nearly twice as long as broad at apex; third tergite as long as broad at apex; fourth tergite equal in length to the third; sheath extending slightly beyond apex of abdomen.

Head, thorax and abdomen black; mandible, palpus, tegula and wing base pale creamy yellowish; coxae black; trochanters reddish, more or less blackish at base; femora reddish; four anterior tibiae reddish on lower surface, pale yellowish above; four anterior tarsi yellowish or stramineous with apices brownish; hind tibia brownish-black, with a pale spot above at extreme base and a more or less pale stripe beyond; hind tarsus brownish-black, the first two segments narrowly pale at base; veins and stigma brownish-black.

Male—Very similar to the female in structure and colour.

Holotype—♀, Sweetsburg, Que., July 7, 1936 (G. S. Walley).

Allotype—♂, Hancock, N.Y., Aug. 11, 1935 (H. K. Townes).

Paratypes—♂, 14 ♀ ♀ from following localities: MD.: ♀, Cabin John, July 31, 1916 (R. M. Fouts), ♂, 2 ♀ ♀, Takoma Park, June 20, July 17, 1943 (H. and M. Townes). MICH.: ♀, Cheboygan Co., July 21, 1940 (R. R. Driesbach). N.Y.: 5 ♀ ♀, Bemus Point, July 17, Aug. 14, 15, 18, 1937 (H. K. Townes), ♀, Ithaca, June 16, 1936. ONT.: ♀, Chalk River, July 23, 1937 (J. M. Cameron). QUE.: 2 ♀ ♀, Knowlton, July 1, 2, 1936 (G. S. Walley), ♀, Laniel, June 7, 1941 (C. E. Atwood), Exp. No. 12171-1.

Holotype and paratypes, No. 5703, in Canadian National Collection. Allotype and paratypes in Townes collection. Paratypes in United States National Museum and Driesbach collection.

Cocoon—Length 6.5 mm., diameter 3.5 mm.; colour and markings as in *genuina*, except that in one specimen the blackish annuli are broken up into several large spots.

Host—Unknown.

Casinaria limenitidis (How.)

Plate II, Figs. 1, 12.

1889 *Limneria limenitidis* Howard *in* Scudder, Butterflies of Eastern U.S. and Can., III, 1883, pl. 88, fig. 5.
1897 *Amorphota orgyiae* Howard, U.S. Dept. Agr. Div. Ent. Tech Ser., No. 5, pp. 20, 53.
1901 *Limnerium limenitidis* Howard, Dalla Torre, Cat. Hymen., III, 98.
1914 *Casinaria argyiae* (Howard), Gahan, Proc. U.S. Nat. Mus. XLVIII, 155.
1917 *Casinaria (Amorphota) orgyiae* (Howard), Viereck, Bull. Conn. Geol. Nat. Hist. Surv., No. 22, p. 269.
1918 *Amorphota orgyiae* Howard, Felt. Jl. Ec. Ent., XI, 386.
1925 *Neonortonia graciliforma* Viereck, Can. Ent., LVII, 179, 300.
1926 *Amorphota orgyiae* Howard, Viereck, Trans. Roy. Soc. Can., XX, Sect. 5, 183.
1926 *Neonortonia orgyiae* (Howard), Viereck, 56 Ann. Rept. Ent. Soc. Ont., p. 104.
1928 *Casinaria orgyiae* (Howard), Cushman *in* Leonard, Cornell Univ. Agric. Exp. Sta. Mem., 101, p. 955.
1934 *Casinaria orgyiae* (Howard), Schaffner and Griswold, U.S. Dept. Agric. Misc. Publ. 188, p. 149.
1941 *Casinaria orgyiae* (Howard), Brown, Tech. Bull. Can. Dept. Agric., 31, p. 8.
1945 *Charops limenitidis* (Howard), Townes, Mem. Am. Ent. Soc., No. 11, Pt. II, 608.
1946 *Casinaria limenitidis* (Howard), Townes, Bol. de Ent. Venezolana, V, No. 2, p. 62.

Superficially this species is like *geometrae*, and in some respects it resembles *infesta*, both of which however pertain to quite distinct species groups. Among the species of the present group it is easily distinguished from *lamina* by its much smaller size, less strongly produced propodeum and the less strongly compressed abdomen, and from *genuina* and *canadensis* by the more slender body and especially by the reddish abdomen. It is most similar to *affinis*, *forcipata* and *vadosa* from which it differs in the female in the proportionately broader face (see key) and in the male (male of *vadosa* unknown) by the form of the valves of the aedeagus (Plate II, Fig. 12).

Female—Length 7–10 mm. Head lenticular, temples strongly receding; clypeus and face only slightly longer than width of latter at narrowest point; malar space a little less than one-half basal width of mandible; ocellocular space varying from one-half to nearly two-thirds diameter of lateral ocellus; occipital and hypostomal carinae uniting at point close to base of mandible; antenna 34–37 segmented; face dull, finely evenly roughened and densely punctate.

Mesoscutum dull, finely granular and very densely punctate; scutellum of moderate size, rather broad at apex, the disk immargined except at extreme base, and frequently with a slight median impression at apex; mesopleura dullish, granular and with numerous punctures, speculum more shining but with fine reticulate sculpture; sternaulus weak; propodeum moderately slender, the apex produced to apical two-thirds of dorsal surface of hind coxa; longitudinal sulcus of propodeum distinct and rather narrow; propodeum frequently with more or less distinct irregular lateral longitudinal, and oblique median longitudinal carinae, also with rather coarse

irregular sculpture consisting of numerous rather large irregular punctures and short irregular rugúlae; legs slender; areolet small, petiolate.

Abdomen moderately slender, compressed, second tergite about twice as long as broad at apex.

Head, thorax and propodeum black; mandibles and tegulae yellowish; abdomen reddish, with petiolar segment and second tergite black except at apices, third tergite blackish at base; coxae black, the four anterior coxae sometimes more or less reddish; four anterior trochanters and apical segment of hind trochanter black; femora reddish, the posterior femur usually darker reddish and with apex narrowly fuscous; front tibia pale reddish beneath, shading to yellowish on upper surface; middle tibia pale reddish throughout beneath, with an inconspicuous narrow sub-basal reddish annulus and a broad apical reddish annulus, the latter more or less tinged with fuscous on upper surface, otherwise the tibia pale yellowish; hind tibia rather uniform dark brownish or castaneous, with extreme base yellowish; front and middle tarsi yellowish, the apical segment and the apices of other segments especially on middle tarsi, brownish; hind tarsi dark brownish, the extreme base of first segment yellowish.

Male—very similar to female; abdomen a little more slender, with apical tergites more or less blackish. Apices of valves of aedeagus with a flattened, acuminate process.

Cocoon—As in *genuina* and *canadensis* but smaller and usually with the annuli more or less broken into large blackish spots.

Hosts—This species was originally described from two specimens reared from larvae of *Basilarchia archippus* Cramer, but has not subsequently been reported from this species. Rather, its usual hosts are members of the family Liparidae, notably species of the general *Notolophus*, *Hemerocampa* and *Olene*. Of the material at hand three specimens were reared from *Notolophus antiquus* Linn., two from *Olene plagiata* Wlk., one from *Hemerocampa leucostigma* Abb. and Smith, two from *Hemerocampa* sp. and two from an undetermined species of "tussock". Also at hand are five specimens reared from *Catocala antinympha* Hbn., at Melrose Highlands, Mass. In the literature the following hosts are recorded: *Basilarchia archippus* Cramer (Howard, 1889), *Malacosoma americanum* Fabr. (Felt, 1918), *Hemerocampa leucostigma* Abb. and Smith (Howard, 1897; Viereck, 1926; Schaffner and Griswold, 1934), *Notolophus antiquus* Linn. and *Olene plagiata* Wlk. (Brown, 1941), *Olene basiflava* Pack. and *Hyphantria cunea* Dru. (Schaffner and Griswold, 1934). Notes on the egg laying habits and immature stages are given by Howard (1897).

Type locality—Coalburgh, West Virginia.

Type—Female, United States National Museum.

Distribution—British Columbia (Robson); District of Columbia (Washington); Manitoba (Aweme, Winnipeg); Maryland (Prince George Co.); Massachusetts (Melrose Highlands); New Jersey (Moorestown); New York (McLean Reservation, Tompkins Co.); Ontario (Carp, Cedar Valley, Ottawa, Parry Sound, Petawawa Res., Pt. Pelee); Quebec (Berthierville, Laniel, St. Clothilde); Rhode Island (Westerly); Texas (Brownsville, Victoria); Virginia (Vienna); West Virginia (Bolivar).

Casinaria forcipata n. sp.

Plate II, Fig. 11.

This species is very similar to *limenitidis* but may be distinguished from it by the proportionately narrower face in the female and the differently formed aedeagus of the male as described in the key. In addition it is usually a slightly smaller species than *limenitidis*, with the abdomen in the female a little more slender. the second tergite more elongate and the tergites beyond less deep when viewed from the side.

Forcipata agrees with *affinis* and *vadosa* in facial proportions in the female, and with the former (the male of *vadosa* is unknown) in the structure of the aedeagus. In most other respects these three species are very similar and special care is required in distinguishing between them. Practically the only differences which have been found to be of value in this regard are those contained in the key and even some of these may in the light of more material than is at present available prove somewhat unreliable.

Female—Length 7.5 mm. In structure agreeing with the foregoing description of *limenitidis* except as follows: face distinctly narrower than combined lengths of face and clypeus; malar space slightly more than one-third basal width of mandible; ocellocular space a little less than one-half diameter of lateral ocellus; antenna 32-segmented; abdomen slender, second tergite almost three times as long as broad at apex.

Colour closely resembling *limenitidis* but with the apical 3 or 4 tergites each with a median blackish spot (sometimes occupying most of the tergite) and the hind tibia with a yellowish stripe on upper surface.

Male—Very similar to female in structure and colour. Apices of valves of aedeagus with a slender spine-like process (Plate II, Fig. 11). Often with blackish markings on abdomen more extensive than in female.

Holotype—♀, Biscotasing, Ont., July 19, 1941 (Forest Insect Survey, No. 4193C).

Allotype—♂, Bells Corners (Carleton Co.), Ont., July 24, 1939 (Forest Insect Survey, No. 8502B).

Paratypes— 15 ♂♂, 23 ♀♀ from following localities: ALTA.: ♀, Black Foot Hills, Aug. 7, 1940 (A. R. Brooks). MD.: ♀, Glen Echo, summer, 1922 (J. C. Bridwell), 6 ♂♂, Patuxent Ref[uge], Bowie, July 27, Aug. 4, 1945, Aug. 15, Sept. 11, 1946 (R. T. Mitchell). N.B.: ♂, 2 ♀♀, Sunbury Co., Aug. 23, Sept. 13, 1945 (Forest Insect Survey), ♂, York Co., Sept. 14, 1945 (Forest Insect Survey). N.Y.: ♂, Shokan, July 11, 1936 (H. K. Townes). OHIO: ♂, Hocking Co. (C. H. Kennedy), ♀, same locality, Sept. 12, 1935 (J. N. Knull). ONT.: ♀, Golden Lake, July 23, 1939 (G. S. Walley), ♂, ♀, Petawawa Res[erve] June 29, 25, 1942 (Forest Insect Survey), ♂, South March, July 28, 1944 (Forest Insect Survey). PA.: ♀, Chestnut Hill, 3-10-193? (G. B. Sleesman), ♂, Spring Brook, Aug. 13, 1944 (H. K. Townes). QUE.: ♀, Berthierville, July 12, 1932 (L. Daviault), ♀, Hartwell Canton, July 13, 1941, ♀, Lac a grous, Oct. 12, 1940, ♂, 2 ♀♀, Laniel, Aug. 13, 1940 (C. E. Atwood), Aug. 30, Sept. 5, 1945, ♀, Lanoraie, Aug. 19, 1940, 2 ♀♀, Nominingue, June 4, 12, 1941 (Peck and Walley), ♀, Shawville, Oct. 12, 1940 (Forest Insect Survey),

♀, Tenaga, Sept. 4, 1940 (Forest Insect Survey), 3 ♀ ♀, (locality unknown). SASK: ♀ Saskatoon, June 22, 1923 (N. J. Atkinson). ♀, (locality illegible) 23-9-96 (Coll. U.S. Nat. Mus.). ♂, Huron Mts., L[ake] S[uperior], 24-8 (Coll. U.S. Nat. Mus.).

Holotype, allotype and paratypes No. 5704 in Canadian National Collection. Paratypes in United States National Museum, Townes collection and Mitchell collection.

Cocoon—Similar to *limenitidis*.

Hosts—The holotype and allotype of this species were reared from *Semiothisa oweni* Swett and *Semiothisa granitata* Gn., respectively, and among the paratypes are additional specimens reared from these hosts and also from *Semiothisa sexmaculata* Pack. and *Physostegania pustularia* Gn. All these records are derived from the material noted above as provided by the Forest Insect Survey of the Division of Entomology.

Remarks—Three female specimens from the Santa Cruz Mountains, Calif. and a single male from Oakhurst, Calif. are for the present referred to this species. The females differ slightly from most eastern specimens in their somewhat finer and evener propodeal sculpture. In this respect they agree with three other females at hand from Presidio, Texas, Williams, Ariz. and Las Cruces, N. Mex., which latter however lack blackish markings on the apical abdominal tergites. Both these small lots may represent geographic variants of the present species or possibly very closely allied species but further material from the southwestern region of the United States will be necessary before solving these problems.

Casinaria affinis n. sp.

Plate II, Fig. 2.

Resembles *limenitidis* but differs from that species in the female in the proportionately narrower face, and in the male in the form of the valves of the aedeagus. In these respects it agrees with *forcipata* from which it is best distinguished by its larger size, reddish post-petiole, more uniformly coloured hind tibia and the absence of blackish markings on the apical tergites of the abdomen. From *vadosa*, which it also closely resembles, it differs in the form of the propodeal sulcus and the colour of the coxae and post-petiole as noted in the key.

Female—Length 9.5 mm. Structure agreeing with the description of *limenitidis* except as follows: face distinctly narrower than combined lengths of face and clypeus; malar space approximately one-third basal width of mandible; ocellocular space one-half diameter of lateral ocellus; antenna 37-segmented; propodeum more evenly sculptured, with less conspicuous rugulae.

Colour very similar to *limenitidis* but usually with the entire post-petiole and the abdomen beyond the second tergite reddish, sometimes with the second tergite reddish except at the base; legs less distinctly banded than in *limenitidis*, the middle tibia lacking a sub-basal annulus and with the upper surface pale yellowish except at the extreme apex; hind tibia with a very narrow pale yellowish spot or annulus at the base, beyond almost uniformly reddish becoming slightly dusky on upper surface towards the apex.

Male—Apices of valves of aedeagus terminating in a cylindrical spine-like process. Colour as in the female.

Holotype—♀, McClellanville, S.C., May 18, 1944 (H. and G. Townes).

Allotype—♂, McClellanville, S.C., May 20, 1944 (H. K. Townes).

Paratypes—2 ♂♂, 24 ♀♀, from following localities: Colo.: ♂, locality unknown (C. F. Baker Coll., No. 2075). Md.: 12 ♀♀, Patuxent Ref[uge], Bowie, Oct. 7 to Nov. 9, 1945 (R. T. Mitchell), 2 ♀♀, Takoma Park, Sept. 11, 1943, Nov. 12, 1944 (H. and M. Townes). N.C.: 2 ♀♀, Cedar Mt., Sept. 5, 1939, Oct. 4, 1941 (H. Townes). Ont.: ♂, ♀, ex Harrington Coll., Nos. P484 and P494—without locality data but both probably taken near Ottawa, Ont., the former* being the specimen described by Provancher as the male of [*Campoplex*] *Campoplegidea scalarius* (Prov.). Pa.: 2 ♀♀, Spring Brook, July 7, 1945 (H. Townes). Que.: ♀, Lac des Ecorces, June 24, 1938 (Forest Insect Survey). S.C.: ♀, McClellanville, May 17, 1944 (H. and M. Townes). W. Va.: 3 ♀♀, Bolivar, Sept. 20, 21, 1942 (H. K. Townes).

Holotype, allotype and paratypes in Townes collection. Paratypes in Canadian National Collection (No. 5705), United States National Museum and R. T. Mitchell Collection.

Cocoon—Similar to *limenitidis*.

Host—Unknown.

Casinaria vadosa n. sp.

This species differs from the three preceding species in having the propodeal sulcus only very slightly impressed, the propodeal sculpture somewhat finer and the front and middle coxae more extensively pale yellowish. It differs further from *limenitidis* and agrees with *forcipata* and *affinis* in the proportionately narrower face in the female.

Female—Length 7.5 mm. Structure very similar to *affinis* except in respect to the propodeal sulcus and sculpture as noted above. Colour as in *affinis* but with the post-petiole almost entirely blackish, the hind tibia with a yellowish stripe near the middle on the upper surface (as in *forcipata*) and the front and middle coxae pale yellowish except at the base.

Male—Unknown.

Holotype—♀, Atlanta, Ga., March 29, 1935 (P. W. Fattig).

Paratype—♀, Atlanta, Ga., June 6, 1941 (P. W. Fattig).

Holotype and paratype in United States National Museum.

Cocoon—Unknown.

Host—Unknown.

* The writer is indebted to Mr. Noel M. Comeau, authority on the Provancher collections, at the Quebec Provincial Museum, for supplying this information.

TWO NEW SPRING WHEATS[1]

J. G. C. Fraser[2]

Central Experimental Farm, Ottawa, Canada

[Received for publication June 27, 1947]

Licences have been granted for two new spring wheat varieties, Saunders C.A.N. 3516 and Cascade C.A.N. 3593. These varieties give promise of making material contributions to the spring wheat growing areas for which they are adapted.

Saunders originated as a cross made by the Cerealists of the Central Experimental Farm, Ottawa in 1938, between an early ripening Brandon hybrid, C-26-44.7 (Hope × Reward) and Thatcher. This variety appeared in the Co-operative Test of Wheat Varieties in 1943 to 1946 as CT 406 and in the Co-operative Test of Early Wheat Varieties in 1942 to 1946 as 40-31.

Saunders is beardless, except for a few tip awns; chaff smooth and white; straw strong and slightly shorter than Thatcher; kernels dark red, ovate in shape and closely resemble Marquis in type. It matures one to two days ahead of Thatcher and about five days ahead of Marquis and about the same time as Garnet. Saunders is resistant to stem rust and loose smut; moderately resistant to bunt, root rot and Black chaff and moderately susceptible to leaf rust but definitely superior in this respect to Red Bobs and Thatcher.

Saunders has been a close competitor of Thatcher in yield in Northern Alberta and slightly exceeded it in the four-year test 1943–46. In the same period in the Alberta tests, it exceeded Marquis, Red Bobs and Redman by two to four bushels per acre. It has shown to best advantage in Northern Alberta, but has done fairly well in Northern Saskatchewan, also. It does not appear so well suited to Manitoba. In milling and baking quality, Saunders is of the same general quality as Marquis and is, therefore, acceptable for the Manitoba Northern Grades.

There will be approximately two hundred and ten bushels propagated in 1947 and it is anticipated there will be sufficient seed available in 1948 for a limited distribution.

The other wheat, Cascade, arose from a cross also made by Cerealists of the Central Experimental Farm, Ottawa in 1936, between $\frac{\text{(Quality A} \times \text{Pacific Bluestem)}}{\text{C-26-59.2 D}} \times$ Onas. Cascade has a medium long, beardless head with white smooth chaff. Its straw is moderately long and strong; kernels white and ovate. It ripens in about the same number of days as Marquis. It is highly resistant to stem rust and mildew; moderately resistant to loose smut and moderately susceptible to bunt and leaf rust.

Cascade is a soft wheat, but is not specially recommended for the pastry trade. It has, however, fair quality for general household purposes.

This variety has been an outstanding yielder wherever it has been tested. It has done exceptionally well on Vancouver Island and at all the Eastern Branch Farms and Stations. It is being increased this year (1947) at several points in Eastern Ontario, Quebec and the Maritime Provinces, and to a limited extent on Vancouver Island. It is not recommended for growing in the Prairie Provinces.

[1] Cereal Division Contribution No. 142.
[2] Agricultural Scientist Grade V.

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1. Principles of animal biology. A. Franklin Shull. Sixth edition. New York, McGraw-Hill book company, inc., 1946. 425 p. figs. tabs. References at ends of chapters.
2. Flour milling technology. Leslie Smith. Third and revised edition. Liverpool, The Northern publishing co., ltd., 1944. 571 p. diagrs.
3. Chemistry and methods of enzymes. James B. Sumner and G. Fred Somers. Second edition revised and enlarged. New York, Academic press inc., 1947. 415 p. figs. tabs. References at ends of chapters.
4. The Canadian bacon board. Alfred Stoddard Miller. Kingston, 1947. 80 p. (typewritten) (Thesis: Queen's university. Faculty of arts)
   "This thesis is primarily a collection of the work of economists and agriculturists interested in the part that live stock plays in the Canadian agricultural economy." From the text.
5. A guide to historical method. Gilbert J. Garraghan. New York, Fordham university press, 1946. xv, 482 p. Bibliography of historical method: pp. 427-431. Appendix: Bibliographical citation in the social sciences; A handbook of style. Livia Appel. Madison, The university of Wisconsin press, 1946. 30 p.
6. The book of houses. John P. Dean and Simon Breines. New York, Crown publishers, 1946. 144 p. photographs. plans.

AGRICULTURAL ENGINEERING

7. Your farmhouse ... how to plan remodeling. Wash., 1947. 23 p. figs. (U.S. Dept. of agriculture. Miscellaneous publication no. 619)
8. Reinforced brick grain bins ... (In Rhodesia agricultural journal. March-April, 1947. pp. 82-92)
9. Brush and tree removing machinery. Maurice B. Cox. Stillwater, 1947. 32 p. figs. pl. (Oklahoma agricultural experiment station bulletin 310)
10. Temporary or emergency silos: Directions for building above-ground fence and paper silos and trench silos. Urbana, University of Illinois, College of agriculture, Dept. of agricultural engineering, 1945. 13 p. il. (mimeo.)
11. Specifications for farmstead wiring ... Wash., U.S. Dept. of agriculture, Rural electrification administration, 1947. 19 p. figs. (mimeo.) (Form AL-23R. 1-47)
12. A simple plough-equipment for applying liquid fumigants to the soil. K. M. King and H. Andison. Ottawa, 1947. 6 p. figs. (Canada. Dept. of agriculture. Division of entomology processed publication no. 68)
13. Reinforced brick grain bins. Salisbury, 1947. 12 p. pl. (Rhodesia. Dept. of agriculture and lands bulletin no. 1389)
14. List of farm building plans. C. J. Hutchinson. Baton Rouge, 1946. 25 p. (Louisiana. State university extension bulletin no. 5)
15. Work simplification news letter. Lafayette, Indiana. 1947. 26 p. (mimeo.) (Purdue work simplification laboratory issue no. 17)
16. Electric milk pasteurizers for farm dairies ... J. P. Schaenzer and S. Shiozawa. Wash., U.S. Dept. of agriculture. Rural electrification administration, 1946. 11 p. (mimeo.)
17. Construction details for making a mechanical post hole digger. H. H. Kob and O. J. Trenary. Fort Collins, 1947. fold. il. (Colorado. Agricultural and mechanical college extension service circular 144-A)
18. Turkey production and equipment. P. H. Gooding and L. W. Herrick. Clemson, S. C., 1947. 30 p. figs. (Clemson agricultural college extension circular 297)
19. Mow-dried hay. Leonard G. Schoenleber and R. B. Davis. Wash., 1947. 8 p. figs. (mimeo.) (U.S. Dept. of agriculture. Bureau of plant industry, soils and agricultural engineering information series 78)
20. Landscape architecture on the farm. J. J. Voorendyk. (In Farmer's weekly, June 11, 1947. pp. 54-7, 87)
21. Air flow through baled hay ... A. T. Hendrix. (In Agricultural engineering, June, 1947. pp. 259-260)

BOTANY

22. Fungi. Volume One. An introduction to fungi, stressing their structure, classification, activities, and natural economy. Frederick A. Wolf and Frederick T. Wolf New York, John Wiley and sons, inc., 1947. 438 p. figs. References through the text.
23. A short history of the Rancho Santa Ana botanic garden. Philip A. Munz. Anaheim, Cal., Rancho Santa Ana botanic garden, 1947. 31 p. il.
24. Geographic range and internal distribution of the mosses indigenous to New Zealand. William Martin. (In Royal society of New Zealand. Transactions and proceedings. Vol. 76. Part 2, September, 1946. pp. 162-184)
25. The Begoniaceae of Colombia. L. B. Smith and B. G. Schubert. (Reprinted from Caldasia. Vol. IV, May-October, 1946) (Harvard university. Gray herbarium contribution CLXIV)
26. Identifications and reidentifications of North American plants. M. L. Fernald. (Reprinted from Rhodora, Vol. 48, July-September, 1946) (Harvard university. Gray herbarium contributions CLXII)
27. An introduction to botany. Arthur W. Haupt. Second edition. New York, McGraw-Hill book company, inc., 1946. 425 p. figs.

27a. Aromatic plants of India. Part I. S. Krishna and R. L. Badhwar. (In Journal of scientific and industrial research. Vol. VI, no. 2, February, 1947. Supplement, pp. 1-24.

28. Investigations on the early flowering of jute (Corchorus capsularis L.) sown in March. J. C. Sen Gupta and N. K. Senn. (In The journal of the Indian botanical society, Vol. XXVI, no. 1. February, 1947. pp. 41-49)
29. Liège. Université. Institut de botanique. Archives. Vol. 17, 1940-1945. Liège, Editions L'Horizon nouveau, 1946. il.

    Contents: 1. Ray. Bouillenne: Les hormones végétales. 2. P. Prevot: Les facteurs de la morphogénèse des bourgeons de néoformation chez "Begonia Rex". 3. L. Delarge: Etude de la croissance et de la ramification des racines in vitro. 4. J. Moureau: Rhizogénèse chez Coleus sous l'influence de l'hétéroauxine. Histologie et physiologie du phénomène. 5. R. Bouillenne, J. de Roubaix et O. Lazar: Action des hormones sur la croissance de la betterave sucrière ...
30. Types of some American trees. M. L. Fernald. (Reprinted from Journal of the Arnold Arboretum. Vol. XXVII, 1946. pp. 386-394)
31. The common names of grasses in South Africa. L. K. A. Chippindall. Pretoria, 1946-7. 91 p. (South Africa. Dept. of agriculture bulletin 265)

CHEMIC TECHNOLOGY

32. Yield and chemical composition of oil from castor beans grown in Oklahoma. J. E. Webster and others. Stillwater, 1947. 18 p. tabs. (Oklahoma. Agricultural experiment station technical bulletin no. T-27)
33. A nutrient element slighted in agricultural research (sulphur) Frederick J. Alway. (Reprinted by Texas Gulf sulphur company from Journal of the American society of agronomy, Vol. 32, no. 12, December 1940)
34. Economic study of German synthetic waxes. J. Vernon Steinle. London, H.M. stationery office, 1946. 32 p. (mimeo.) (British intelligence objectives subcommittee. F.I.A.T. final report no. 737. Item no. 22)
35. German pectin industry during World war II. Z. I. Kertesz. London, H.M. stationery office, 1945. 31 p. (mimeo.) (British intelligence objectives subcommittee. F.I.A.T. final report no. 567. Item no. 22)
36. Australian tea trees of economic value. Part I. (Third edition) A. R. Penfold and F. R. Morrison. Sydney, Government printer, 1946. 16 p. il. (New South Wales. Technical education branch. Technological museum bulletin no. 14)
37. Ramie and ramie products. H. H. Hawker. Columbus, National farm chemurgic council, 1947. 11 p. (mimeo.) (Chemurgic papers 1947 series no. 4. No. 577)
38. Producing fibers on the farm. A. P. Belanger. Columbus, National farm chemurgic council, 1947. 4 p. (mimeo.) (Chemurgic papers 1947 series no. 4. No. 582)
39. Farm products required for the manufacture of high quality lubricants. E. W. Nelson. Columbus, National farm chemurgic council, 1947. 11 p. (mimeo.) (Chemurgic papers 1947 series no. 4. No. 586)
40. Nylon from agricultural byproducts. O. W. Cass. Columbus, National farm chemurgic council, 1947. 5 p. (mimeo.) (Chemurgic papers 1947 series no. 4. No. 587)
41. Queensland society of sugar cane technologists. Proceedings of the fourteenth conference, Innisfail, 1947. Brisbane, 1947. 276 p. figs. tabs.
42. Waldhof process for production of food yeast. J. M. Holderby. London, H.M. stationery office, 1946. 9 p. (mimeo.) (British intelligence objectives subcommittee F.I.A.T. final report no. 619. Item no. 22)

CLIMATE

43. Proposals for starting phenological observations on an All-India basis. (In The Indian ecologist, Vol. 1, no. 2. January, 1947. pp. 6-15)
44. Agricultural climatology of Poland and its agro-climatic analogues in North America. M. Y. Nuttonson. Wash., American institute of crop ecology, 1947. 12 p. charts. bibl. (International agro-climatological series. Study no. 2)
45. Ecological crop geography of the Ukraine and the Ukrainian agro-climatic analogues in North America. M. Y. Nuttonson. Wash., American institute of crop ecology 1947. 24 p. tabs. charts. bibl. (International agro-climatological series. Study no. 1)

COOPERATION

46. Russian collective farms. Alec Brown. (In Farming, July-August, 1947. pp. 283-285)
47. Co-operative farm planning. Published by the Department of reconstruction and rehabilitation and the Department of co-operation and co-operative development. Regina, King's printer, 1947. 60 p. il.
48. Co-operative research in the wool industry. B. H. Wilson. (In Board of trade journal, Vol. 153, no. 2636, June 28, 1947. pp. 1057-59)

DAIRY—DAIRY RESEARCH

49. Further developments in dairying in Germany. London, H.M. stationery office, 1946. 44 p. figs. pl. (British intelligence objectives subcommittee. B.I.O.S. final report no. 770. Item nos. 22, 31)
50. New York state association of milk sanitarians. Twentieth annual report, 1946. Compiled by W. D. Tiedeman, N.Y. state department of health. Albany, 1947. 258 p. figs. tabs.
51. The story of Maple Leaf processed cheese. C. H. Kenny. (In Canadian food industries, July, 1947. pp. 12-14)
52. Dairy farming as a business ... Wyn F. Owen. [In Review of marketing and agricultural economics (N.S.W., Aust.) April, 1947. Vol. 15, no. 4. pp. 123-146]
53. Powers and functions of new dairy commissions ... (In New Zealand dairy exporter, May 1, 1947. pp. 4-5, 31)
54. Calcium content of fluid milk. C. H. Robinson, I. Hlynka, F. A. Herman and J. W. McArthur. (Reprinted from the Canadian journal of public health, May, 1947) (Canada. Dept. of agriculture. Science service, Division of chemistry contribution no. 128)
55. Some effects of types of shelter upon dairy cattle. J. R. Rice. Fargo, 1947. 21 p. figs. tabs. (North Dakota. Agricultural experiment station bulletin 344)

ECONOMICS

56. Statement of present policy on Prairie farm rehabilitation ... Hon. J. G. Gardiner. (In Hansard, May 22, 1947)
57. Chinese national policies affecting agricultural trade ... (In Foreign agriculture, July 1947. pp. 99-103)
58. Michigan's major agricultural problems ... A report of the Agricultural advisory committee of the Michigan planning commission. Published by the Michigan planning commission and Michigan agricultural extension service. Lansing, 1946. 31 p.
59. Report on the progress of agricultural production in Australia, April 1947. (Canberra) Department of commerce and agriculture. Bureau of agricultural economics. 48 p. (mimeo.) (Tenth report in monthly series)
60. Agricultural, pastoral, and forest industries in Argentina ... Wash., U.S. Tariff commission, 1947. 96 p. tabs. (processed)
61. Economic aspects of war-time farming East, and South-East Scotland 1939-40 to 1944-45. J. D. Nutt. Edinburgh, 1947. 102 p. figs. tabs. (Edinburgh and East of Scotland college of agriculture bulletin no. 2)
62. The story of Cornell's farm and home special. Ithaca, n.d. n.p. il. (Cornell miscellaneous bulletin no. 3)
63. Agricultural, pastoral, and forest industries in Cuba. Wash., U.S. Tariff commission, 1947. 64 p. tabs. (processed)
64. Newfoundland (Summary of current economic information) Wash., U.S. Dept. of commerce. 4 p. il. (International reference service. Volume 4, no. 7. April, 1947)
65. Sweden (Summary of current economic information). Wash., U.S. Dept. of commerce. 6 p. il. (International reference service. Volume 4, no. 14. July, 1947)
66. Better farm leases. (In Illinois farm economics. May, 1947. no. 144. pp. 485-503)

FEEDING AND FEEDING STUFFS

67. Delivering feed in bulk ... (In Grain and feed journals consolidated. July 9, 1947. p. 36)
68. Feedlot finishing of cattle and sheep in the irrigated areas of Southern Alberta. Frank Whiting. Ottawa, 1947. 65 p. figs. tabs. (Canada. Dept. of agriculture. Publication 786. Farmers' bulletin 140)
69. The toxic principle of the tung tree. M. W. Emmel. Gainesville, 1947. 34 p. figs. tabs. (Florida Agricultural experiment station bulletin 431)
70. Free-choice feeding of laying hens. J. E. Parker and O. A. Barton. Fargo, 1947. 11 p. tabs. (North Dakota agricultural college. Agricultural experiment station bulletin 345)
71. Quantity of feeds required and cost of producing butterfat. G. Q. Bateman. Logan, 1946. 16 p. (mimeo.) (Utah. Agricultural experiment station mimeograph series 324)

FERTILIZERS

72. Miscellaneous methods of fertilizer application. (In Soils and fertilizers. Vol. X, no. 2. 1947. pp. 117-122)
73. Fertilizers made by I. G. Farbenindustrie A. G. at Leuna and Piesteritz. London, H.M. stationery office, (1946) 56 p. figs. (British intelligence objectives sub-committee F.I.A.T. final report no. 718. Item no. 22)
74. Fertilizer studies with the Red McClure and Bliss Triumph varieties of potatoes in the San Luis Valley. J. G. McLean and others. Fort Collins, 1947. 20 p. tabs. (Colorado. Agricultural experiment station technical bulletin 35)
75. Fertilizers, soil analysis, and plant nutrition. D. R. Hoagland. Berkeley, 1947. 24 p. figs. (California. Agricultural experiment station Circular 367)
76. Compost and how to make it. Edited by J. I. Rodale. Emmaus, Pa., Organic gardening, 1945. 63 p.
77. Tracer technique in wheat studies. Erwin Kreutzweiser. (In C-I-L oval, June, 1947. pp. 8-9)

FOOD—FOOD PRESERVATION

78. Food products. Saul Blumenthal. Brooklyn, Chemical publishing co., inc., 1947. 986 p.
79. Synthetic food adjuncts; synthetic food colours, flavours, essences, sweetening agents, preservatives, stabilizers, vitamins, and similar food adjuvants. Morris B. Jacobs. New York, D. Van Nostrand company, inc., 1947. 335 p. tabs.
80. German air-conditioning and refrigeration industry. Gunnar Berg. London, H.M. stationery office, 1945. 37 p. (mimeo.) (British intelligence objectives sub-committee F.I.A.T. final report no. 573. Item no. 31)
81. Observations on the German fruit juice industry. Reported by Z. I. Kertesz. London, H.M. stationery office, 1945. 11 p. (mimeo) (British intelligence objectives sub-committee J.I.O.A. final report no. 50. Item no. 22)
82. Home canning of fruits and vegetables. Ottawa, 1947. 32 p. (Canada. Dept. of agriculture. Publication no. 789. Consumer bulletin 1)
83. Freezing fruits and vegetables. Ottawa, 1947. 10 p. (Canada. Dept. of agriculture. Publication 773. Household bulletin 21 revised)
84. Concentration of juice from Michigan fruits by freezing. Pauline Paul. (In Michigan state college quarterly bulletin. Vol. 29, May 1947. no. 4. pp. 271-273)
85. Preparation of peaches for freezing. J. G. Woodroof and others. Experiment, 1947. 70 p. figs. (Georgia. Agricultural experiment station bulletin 251)

GENETICS

86. Genetic research in Britain, 1939-1945. (In Heredity, July, 1947. Vol. 1, part 1, pp. 1-17)
87. A bibliography of genetic research published in Italy and Germany, 1939-1945. A. Buzzati-Travero. (In Heredity, Vol. I, part 1, July, 1947. pp. 19-51)

HORTICULTURE

88. The Massachusetts fruit growers' association, inc. Report of the fifty-third annual meeting, 1947. Amherst, 1947. 187 p.
89. Strawberries. London, H.M. Stationery office, 1947. 38 p. figs. (Great Britain. Ministry of agriculture and fisheries bulletin no. 95. 3d edition)
90. Michigan state horticultural society. Seventy-sixth annual report, 1946. Lansing, 1947. 179 p.

HORTICULTURE—Continued

91. Community garden league of Greater Montreal. 15th annual report, 1946. Montreal, Montreal parks and playgrounds association inc., 1947. 8 p. (mimeo.)
92. American rock garden society. Bulletin. Year book number, 1945-1946. Vol. 4, no. 3. May-June, 1946. Plainfield, American rock garden society. 52 p. il.
93. Rustless black currants ... A. W. S. Hunter. (In Canadian grower, June, 1947. pp. 8, 26)

INSECTS—PESTS—INSECTICIDES

94. The Cerambycidae or long-horned beetles of Georgia. P. W. Fattig. Emory University, Ga., Emory university, 1947. 48 p. bibl. (Emory university museum bulletin no. 5)
95. Le milieu intérieur des insectes. Jean Timon-David. (Photoprint, Année biologique, Paris. ser. 3, vol. 21. pp. 113-154, 1945)
96. A review of the insecticidal uses of the rotenone-bearing plants, 1938-1944. N. E. McIndoo. Wash., 1947. 201 p. (mimeo.) (U.S. Dept. of agriculture. Bureau of entomology and plant quarantine. E-713)
97. Interim report on two scales attacking the Bermuda cedar. W. R. Thompson. (Hamilton) Bermuda department of agriculture. 1947. 3 p.
98. Pest control handbook. Harston, Cambridge, Pest control ltd., 1947. 56 p.
99. Swinging-shutter apparatus for measuring small dosages of insecticidal aerosol. E. R. McGovran and J. H. Fales. Wash., 1947. 10 p. figs. (mimeo.) (U.S. Dept. of agriculture. Bureau of entomology and plant quarantine. ET-239)
101. The control of aphids in field and garden in British Columbia. R. Glendenning. Ottawa, 1947. 4 p. (Canada. Dept. of agriculture. Division of entomology processed publication no. 71)
102. Control of Lygus bugs in alfalfa seed fields in Saskatchewan. H. McMahon and A. P. Arnason. Ottawa, 1947. 3 p. (Canada. Dept. of agriculture. Division of entomology processed publication no. 67)
103. Control of the strawberry weevil. C. W. B. Maxwell. Ottawa, 1947. 4 p. (Canada. Dept. of agriculture. Division of entomology processed publication no. 66)
104. Insect nutrition. William Trager. (In Biological reviews, April, 1947. pp. 148-177)
105. Rats and their control. Fort Collins, 1947. 8 p. (Colorado A & M college extension service circular 145-A)
106. Monument to an insect ... Arthur Gibson. (In Farmer's magazine, June, 1947. p. 10)
106a. Tyroglyphid mites in stored products in New Zealand. P. L. Robertson. (In Royal society of New Zealand. Transactions and proceedings. Vol. 76, part 2, September, 1946. pp. 185-207)

LIVE STOCK—BREEDING

107. The relative effects of inbreeding and outbreeding on reproduction in the domestic fowl. Paul Emile Bernier. Ottawa, 1947. 185 p. (tpw.) Literature cited: pp. 184-195. (Thesis: University of California. Graduate division)
108. Fjerkraeavl og fjerkraehold. S. Buus, J. Baelum, David Davidsen, A. Stenbaek. (Poultry breeding and keeping in Denmark) Copenhagen, Danske landhusholdningsselskab, 1945. 323 p. figs. tabs.
109. The Danish poultry industry and its development. W. A. Kock. Poultry keeping in Denmark during and after the war. N. P. Vonsbaek. (In World's poultry science journal, April-June, 1947. pp. 70-73, and pp. 74-76)
110. Ley farming and the live stock population. Martin Jones. (In Journal of the farmers' club, part 5, 1947. pp. 60-72)
111. A turning point in breeding progress ... A. L. Hagedoorn. (In The farmers weekly, July 11, 1947. pp. 40-41)
112. Researches in the physiology of reproduction done in Cambridge: A brief history. F. H. A. Marshall. (In Cambridge university. School of agriculture memoir no. 19, 1947. pp. 9-12)
113. Milk goats. E. C. Scheidenhelm and Earl Weaver. East Lansing, 1947. 20 p. figs. (Michigan. State college extension service bulletin 284)
114. Studies on the breeding performance of ewes. R. B. Kelly. Melbourne, 1946. 28 p. tabs. (processed) (Australia. Council for scientific and industrial research bulletin no. 205)
115. Growth and development in three types of turkeys. G. P. Goodearl. Fargo, 1947. 13 p. (North Dakota. Agricultural experiment station bulletin 343)
116. Livestock and meat situation of France. Digested from a report by B. H. Thibodeaux. Wash., U.S. Dept. of commerce, 1947. 5 p. (Industrial reference service. Part 5. Foodstuffs, fats and oils. Vol. 5, part 5. May, 1947. no. 11)
117. Canadian sheep review, 1946. Weston, The Canadian sheep breeders' association, n.d. 28 p.

MARKETING—MARKETS

118. Farmers' produce markets in the United States. Part II. Plans and facilities. W. M. Hurst. Wash., 1947. 39 p. (processed) 83 figs. (U.S. Dept. of agriculture. Farm credit administration. Cooperative research and service division miscellaneous report no. 107)
119. Le commerce des produits agricoles dans le Nord-Ouest du Québec. Henri Dubord et E. P. Reid. Québec, 1947. 142 p. il. (Québec. Ministère de l'agriculture bulletin technique) (In English and French)

PASTURES—RANGES

120. Advances in grassland husbandry and fodder production. Second symposium. Aberystwyth, 1947. 83 p. figs. tabs. (Imperial bureau of pastures and field crops bulletin no. 38)
121. Combination ranching in Southeastern New Mexico. H. B. Pingrey. State College, 1946. 56 p. tabs. (New Mexico. College of agriculture and mechanic arts. Agricultural experiment station bulletin 332)
122. Irrigated pastures in California. B. J. Jones and J. B. Brown. Berkeley, 1947. 48 p. il. (California. College of agriculture. Extension service circular 125, revised)

PHYTOPATHOLOGY

123. Report of plant pathologist, Delaware state board of agriculture, 1946. Dover, 1947. 30 p. il. tabs. (Quarterly bulletin, Volume 37, no. 1)
124. Plant diseases in commercial flower production. A. W. Dimock. (In Canadian florist, June 20, 1947. pp. 7-8)
125. Stuifbrand specialisatie, een probleem voor den kweker onderzoekingen over stuifbrand, III. Summary: Specialisation of loose smut of wheat, a problem for the breeder. Research on smut, III. A. J. P. Oort. (Overdruk uit het Tijdschrift over plantenziekten, 53e jrg. Mrt-Apr. 1947. 25-43)
126. Physiology of Fusarium foot rot of squash. George A. Gries. New Haven, 1946. 20 p. figs. tabs. (Connecticut. Agricultural experiment station bulletin 500)
127. De biochemie van het parasitisme. Summary: Biochemistry of parasitism. Ir. J. Sneep. (Overdruk uit Tijdschrift over plantenziekten, 2e jrg. 5e en 6e afl. Sept.-Dec. 1946. 125-137)

PLANT BREEDING

128. Russian dandelion (Kok-saghyz) ... Compiled by W. Gordon Whaley and John S. Bowen. Wash., 1947. 212 p. figs. tabs. Literature cited: pp. 184-212. (U.S. Dept. of agriculture miscellaneous publication 618)
129. Report of tobacco substation at Windsor for 1946. New Haven, 1947. 26 p. figs. tabs. (Connecticut. Agricultural experiment station bulletin 504)
130. Board of grain commissioners. Grain research laboratory. Twentieth annual report, 1946. Ottawa, Dept. of trade and commerce, 1947. 79 p. figs. tabs.
131. Production des légumes secs en Algérie ... Alger, 1945. 19 p. (Algérie. Gouvernement. Direction générale des affaires économiques. Documents et renseignements agricoles. Bulletin no. 117)
132. Independence in inheritance of the loose smut reaction and lemma colouration in an oat cross. N. M. Patel. Anand, 1943. 27 p. tabs. bibl. (Anand. Institute of agriculture. Botanical series bulletin no. 1)
133. The theory of plant breeding for yield. O. H. Frankel. (In Heredity, Vol. 1, part 1, July, 1947. pp. 109-120)
134. The early history of seed treatment in England. F. A. Buttress and R. W. G. Dennis. (In Agricultural history, April, 1947. pp. 93-103)
135. Annual report on winter wheat improvement in Ontario, Fourth, 1946. Guelph, Ontario agricultural college, 1947. 30 p. tabs. (mimeo.)
136. Better tobacco plants (by improved methods) Raleigh, 1946. 12 p. (North Carolina.) State college of agriculture and engineering extension circular no. 293)
137. An evaulation of the self-tripping character in breeding for improved seed yield in alfalfa. T. M. Stevenson. (In Empire journal of experimental agriculture, April, 1947. pp. 82-88)

RESEARCH

138. Science in farming. The yearbook of agriculture, 1943-1947. Wash., U.S. Dept. of agriculture, 1947. 944 p. figs. tabs. pl.
139. The agricultural problem of India. S. Ranjan. (In Journal of the Indian botanical society. Vol. XXVI, no. 1, February, 1947. pp. 1-8)
140. New concepts in agricultural science. W. E. Van Steenburgh. Toronto, 1947. 8 p.

RESEARCH—Continued

141. The value and function of scientific societies. E. G. D. Murray. (Reprinted from Canadian journal of comparative medicine, February 1947. pp. 48-52)
142. Research and the farmer. III. The dairy industry. Norman C. Wright. (In Scottish agriculture, April, 1947. pp. 220-224)

SOILS—CONSERVATION—IRRIGATION—RECLAMATION

143. Forest soils and forest growth. Sergius Alexander Wilde. Waltham, Mass., Chronica botanica co., 1946. 241 p. References: pp. 205-218. (Chronica botanica new series of plant science books. Vol. 18)
144. Studies op de in 1944 overstroomde poldergronden in België ... Summary: Studies over the 1944 overflown polder soils in Belgium. (Agricultura: Bulletin trimestriel de l'Association des anciens étudiants de l'Institut agronomique de l'Université de Louvain, mai, 1947 No. 1-2. pp. 1-69)
145. Elements of soil conservation. Hugh Hammond Bennett. First edition. New York, McGraw-Hill book company, inc., 1947. 406 p. figs. graphs. References at ends of chapters.
146. Central Valley project studies. Wash., U.S. Dept. of the interior. Bureau of reclamation, 1947. 150 p. il. tabs. maps. (The war program problems 1-5)
147. An introduction to the scientific study of the soil. Norman M. Comber. London, Edward Arnold & co., 1936. 206 p. figs.
148. First aid for the irrigator. Wash., 1947. 43 p. figs. (U.S. Dept. of agriculture miscellaneous publication no. 624)
149. Vegetation in drainage ditches causes flooding. C. E. Ramser. Wash., 1947. 9 p. figs. (mimeo.) (U.S. Dept. of agriculture. Soil conservation service. SCS-TP-62)
150. Waterways of India ... Simla S. W., 1947. 38 p. (India. Central board of irrigation popular series leaflet no. 4)
151. Erosion. Do soybeans cause more erosion than corn? by G. N. Browning. (In The soybean digest. Volume 7, no. 8. June, 1947. pp. 10-12)
152. Studies on the influence of precipitation on crop yields in Sweden with special reference to field irrigation. Gunnar Hallgren. (Reprinted from The annals of the Royal agricultural college of Sweden, Vol. 14, 1946. pp. 173-289) Appendix ... Stockholm, 1947. n.p. (mimeo.)
153. Practical soil sterilization with special reference to glasshouse crops. London, H.M. stationery office, 1947. 22 p. figs. (Great Britain. Ministry of agriculture and fisheries bulletin no. 22. 4th edition)
154. United action for soil conservation ... R. H. Musser. (Address before Provincial convention of Agricultural institute of Canada, Guelph, Ontario, May 16, 1947) (In Agricultural institute review. Vol. 2, no. 4, July, 1947. pp. 265-275)
155. Ontario provincial convention at Guelph. Panel discussion on conservation is feature of Guelph meeting. (In Agricultural institute review, Vol. 2, no. 4, July, 1947. pp. 285-295, 303)

TEXTILE INDUSTRY

156. Manual of the textile industry of Canada. 1947 edition. Montreal, Canadian textile journal publishing co. limited, 1947. 216 p. il.

New Periodicals in Library:

Heredity. Edited by Darlington and Fisher. Edinburgh, Oliver & Boyd.
Organic gardening. Edited by J. I. Rodale. Philadelphia, Emmaus.
Journal of clinical investigation. American society for clinical investigation, Baltimore.

The following numbers of periodicals are needed in the library:

Popular science. September, 1946.
Canada lumberman. November 15, 1946.
Science. July 12, 1946.
Science news letter. December 8, 1945 and March 23, 1946.
Pests and their control. January, 1946.
Seed world. October 5, 1945.
Gardener's chronicle of America. June, July and December, 1946.

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